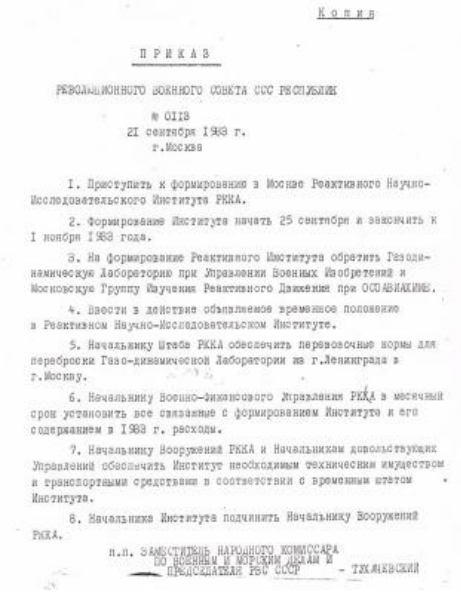
On the works of RNII-NII No. 3 in 1933-1940

Author of materials:
S.V. Gurov (Hero City Tula)

October 31, 2018 marked the 85th anniversary of the founding of the Jet Research Institute (RNII), later renamed Research Institute No. 3 of the People's Commissariat of Ammunition. In the 30s, the specialists of these organizations carried out various works to create samples of jet technology. Over time, the enterprise became one of the main organizations in the country to create products for the rocket and space industry. Now it is the State Scientific Center Federal State Unitary Enterprise “Keldysh Center” (State Scientific Center FSUE “Keldysh Center”).

The article was written based on declassified materials of the Federal State Unitary Enterprise "State Scientific Center named after Keldysh" (Moscow).

The author expresses gratitude to the head of the sector A.A. Gafarov, the general director V.V.Koshlakov, the head of the department A.V. Mitrofanov, leading specialist I.V. (State Scientific Center FSUE “Center of Keldysh”, Moscow) and Deputy Managing Director - Scientific Supervisor - General Designer of JSC “NPO“ SPLAV ”(Tula) Makarovets NA for ensuring work with archival data of the State Research Center FSUE “Keldysh Center”.



Копия

ПРИКАЗ

РЕВОЛЮЦИОННОГО ВОЕННОГО СОВЕТА СОЮЗ РЕСПУБЛИК

№ 0113
21 сентября 1933 г.
г.Москва

1. Приступить к формированию в Москве Реактивного Научно-Исследовательского Института РККА.

2. Формирование Института начать 25 сентября и закончить к 1 ноября 1933 года.

3. На формирование Реактивного Института обратить Газодинамическую Лабораторию при Управлении Военных Изобретений и Московскую Группу Изучения Реактивного Движения при ОСОАВИАХИМе.

4. Ввести в действие объявленное временное положение о Реактивном Научно-Исследовательском Институте.

5. Начальнику Штаба РККА обеспечить перевозочные кормы для переброски Газо-динамической Лаборатории из г.Ленинграда в г.Москву.

6. Начальнику Военно-Хозяйственного Управления РККА в месячный срок установить все связанные с формированием Института и его содержанием в 1933 г. расходы.

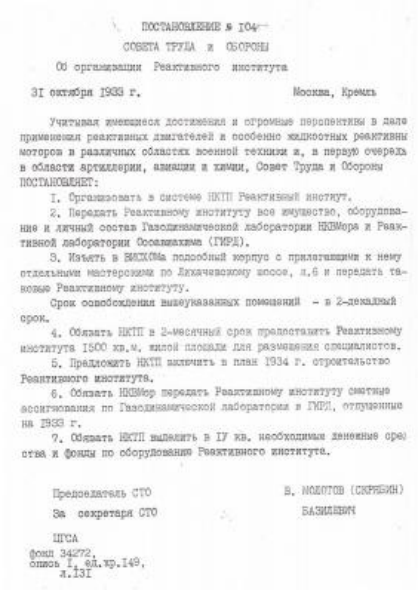
7. Начальнику Вооружений РККА и Начальникам довольствующих Управлений обеспечить Институт необходимым техническим имуществом и транспортными средствами в соответствии с временным штатом Института.

8. Начальника Института подчинить Начальнику Вооружений РККА.

п.п. ЗАМЕСТИТЕЛЬ НАРОДНОГО КОМИССАРА ПО ВОЕННЫМ И МОРСКИМ ДЕЛАМ И ПРЕДСЕДАТЕЛЬ РВС СССР - ТУХАЧЕВСКИЙ

On September 21, 1933, the order of the Revolutionary Military Council of the SSS of the Republics was issued No. 0113 (stamp unknown), in which the task was set to form a Jet Research Institute of the Red Army in Moscow. The formation of the Institute was to take place in the period from September 25 to November 1, 1933 [1].

On the basis of the decree of the Council of Labor and Defense (STO) of October 31, 1933 No. 104 ss and the order of the People's Commissar of Heavy Industry of November 4, 1933 No. 198 ss, Scientific Research Institute No. 3 (SRI No. 3) (in fact, Reactive Research Institute [2], [3]) on the basis of two organizations previously referred to as the Gas-Dynamic Laboratory of the Office of Military Inventions [4] (Narkomvoenmor "a [5]), and the Moscow Group for the Study of Jet Propulsion (GIRD) at the CC CC (CC Osoviachim) [4], [5], [6]. The first of these organizations existed since 1928, and the second since 1931. Moreover, the gas dynamic laboratory was mainly engaged in the development of rockets using the energy of gunpowder for the driving force, and the group for studying jet propulsion developed rockets using liquid fuel components (gasoline,alcohol + liquid oxygen).



ПОСТАНОВЛЕНИЕ № 104
СОВЕТА ТРУДА и ОБОРОНЫ
Об организации Реактивного института

31 октября 1933 г. Москва, Кремль

Учитывая имеющиеся достижения и огромные перспективы в деле применения реактивных двигателей и особенно жидкостных реактивных моторов в различных областях военной техники и, в первую очередь в области артиллерии, авиации и химии, Совет Труда и Обороны ПОСТАНОВЛЯЕТ:

1. Организовать в системе НКТП Реактивный институт.

2. Передать Реактивному институту все имущество, оборудование и личный состав Газодинамической лаборатории НКВМфора и Реактивной лаборатории Осоавиахима (ГИРД).

3. Изъять в ЕАУКОМа подсобный корпус с прилегающими к нему отдельными мастерскими по Лихачевскому шоссе, д.6 и передать таковые Реактивному институту.

Срок освобождения вышеуказанных помещений - в 2-декадный срок.

4. Обязать НКТП в 2-месячный срок предоставить Реактивному институту 1500 кв.м. жилой площади для размещения специалистов.

5. Предложить НКТП включить в план 1934 г. строительство Реактивного института.

6. Обязать НКВМфор передать Реактивному институту сметные ассигнования по Газодинамической лаборатории и ГИРД, отпущенные на 1933 г.

7. Обязать НКТП выделить в IV кв. необходимые денежные средства и фонды по оборудованию Реактивного института.

Председатель СТО В. МОЛОТОВ (СКРЯБИН)
За секретаря СТО БАЗИЛЕВИЧ

ЦГСА
фонд 34272,
опись 1, ед.хр.149,
л.131

As a result of the combination of these two groups, the institute's theme was formed, aimed at the development of solid-fuel rocket aircraft, in the form of missile shells and aerial bombs with an additional speed, and liquid-fuel rocket aircraft in the form of stratospheric missiles, air torpedoes and directly liquid-fuel engines. etc.

It was noted that the most ancient history has rocket shells, the development of which began in 1928. From 1928 to 1935, the development of the stability of the flight of rocket projectiles went along the line of using the gyroscopic effect, tk. called a turbo jet projectile. It is unlikely that this principle in its pure form had the technical justification for such a long experimentation. The shells in this form flew absolutely without keeping any regularity.

In 1933, testing of projectiles began, which were stabilized using a conventional tail unit in the form of a four-blade stabilizer. This method of stabilization almost immediately justified itself and the projectiles retained a very definite pattern of flight.

In some tests, already in 1934-35, the accuracy of the battle of rocket shells reached an accuracy little different from that achieved at that time, i.e. there was enough data for the introduction of shells into the troops in the form of the first stage. Moreover, it was necessary to do this, given that firing rocket projectiles, due to the lack of recoil when fired, does not require a complex launching device. In 1934, under the influence of the pressure of a number of young engineers about the need to carry out tests from an airplane, he was armed with I-5 missiles.

The first experiments showed relatively good results, but further development was suspended due to the fact that when firing missiles from the R-6 aircraft, the latter burned out. Based on this, experiments were suspended until the second half of 1937 [4].

According to the Draft Thematic Plan of Defense Work of the RNII for 1935, work on the following objects was to be carried out in 1935:

# #	No. of objects	Topic name	Special purpose	Whose task	How the work ends in 1935
one	23	Fragmentation rocket 82 mm projectile	Armament of fighter aircraft for air combat	UVAA, GAU	Prototype and report
2	24	Fragmentation rocket 132 mm projectile	Armament of fighter and reconnaissance aircraft for air combat	UVAA, GAU	Prototype and report
3	26	Automatic loader for rockets	Armament of reconnaissance and heavy aviation for air combat	UVVS RKKA	Prototype and report
four	27 a h x m	High-explosive and chemical 245 mm projectile and weapon for it	Armament for cruising and heavy aircraft for shooting at air targets and sea vessels for shooting at the fleet and shore	UVAGAU UVVS VOKHIMU UVMS	Prototype and report
five	25	Test firing 82 mm and 132 mm high-explosive fragmentation rockets	Shooting tables	UBAA GAU RNII	Shooting tables
6	28	Firing test of 68 mm, 76 mm and 132 mm signal and lighting projectiles	Shooting tables	UPVS GAU RNII	Shooting tables
7	41 f / s	High-explosive rocket and illumination 132 mm projectile and ship installation to it	Armament of torpedo boats for firing at sea targets	UVMS	Prototype and report
8	37	Reactive chemical 132 mm and 152 mm projectile and machine tool for it	Arming rifle units with a mass chemical attack	VOKHIMA RKKA	Prototype and report
9	38	Tank mount for 132mm. high-explosive missiles	Armament of the BT-5 tank	UMM RKKA	Prototype and report
ten	42	High-explosive jet aerobomb	Arming fighter and heavy aircraft with concrete-piercing bombs	UBAA GAU	Prototype and report
eleven	43	Reactive propaganda 132mm. shell	Arming rifle units with non-killing propaganda bullets.	PU RKKA	Prototype and report
12	44	Depth Rocket Anti-Launch Bomb	Arming the sea vessels with a powerful high-explosive bomb for shooting at submarines	UVMS RKKA	Prototype and report
Research work:					
thirteen	45a	Experimental study of the issue of increasing the caliber of rocket powder projectiles to 500mm.	Arming ships with a powerful high-explosive projectile for firing at the fleet and the coast	UVMS	Report
14	45b	Experimental study of the combustion of gunpowder in a semi-closed volume	Studying the characteristics of propellants and determining the influence of loading conditions	RNII	Report
15	45c	Experimental studies of smoke, luminous compositions and colored powders	Obtaining stable compositions for signal smoke projectiles	NTU GAU RNII	Report
16	01	Liquid propellant short-range missile	Auxiliary projectile for training and operational purposes	NTU GAU	Prototype and report
17	eleven	Long-range liquid propellant missile	1. Armament of rifle formations and sea vessels with a long-range high-explosive projectile. 2. Apparatus for studying the stratosphere	NTU GAU	Prototype and report
eighteen	14	Jet engine on liquid fuel with a thrust of 500kg.	Engine for rockets, toped boats and sea torpedoes.	UVMS RNII	Prototype and report
19	08	Artillery 76mm projectile with air-jet engine	Increasing the range of existing art weapons	NTU GAU	Prototype and report
		Research work:			
20	46a	Experimental study of liquid fuel processes in a rocket motor	Study of the physical and chemical characteristics of the fuel and engine and the development of rational methods of calculation and design	RNII	Report
21	46b	Experimental study of the aerodynamics of projectiles and rocket vehicles	Increasing the efficiency of motors and obtaining the aerodynamic characteristics of rocket vehicles	NTU GAU RNII	Report
22	46c	Search for new types of liquid fuels for jet engines and experimental study of their physical and chemical properties	Obtaining powerful fuels and developing technological processes for their production	RNII	Prototype and report

23	46g	Development of a jet engine for flights to the stratosphere	Engine for aircraft intended for exploration of the stratosphere	RNII	Design development and report
24	46 / d	Development of refractories for jet engines	Protection of the jet engine from burnout	RNII	Samples and report
25	46 / e	Constructive and theoretical study of the principles of fuel supply to the combustion chamber	Reducing the weight of the rocket structure	RNII	Report and construction diagrams
III O t d e l					
26	eighteen	Launch rocket unit for the TB-3 aircraft	Reducing the takeoff run of a land aircraft during overload	UVVS	Prototype and report
27	15	Jet catapult for aircraft acceleration	Accelerated take-off of land and sea aircraft	RNII	Prototype and report
28	17	Launch rocket unit for seaplane MRD-4	Reducing the takeoff run of a marine aircraft during overload.	UVVS	Prototype and report
29	06	Long-range air jet high-explosive torpedo	Winged projectile of powerful high-explosive action for shooting at ground targets	NTU GAU	Design development and report
thirty	48	Short-range airborne chemical and agitation torpedo	Arming rifle units with powerful chemical and propaganda shells	VOHIMU PURKKA	Prototype and report
31	49	Experimental study of the action of a gas jet on the material part of an aircraft	Development of a method for calculating the strength of an aircraft using a jet engine	RNII	Report
32	49b	Experimental study of various automatic systems missile control	Prototype of an assault rifle for flight control in three planes	RNII	Report
33	49c	Investigation of the issue of taking an airplane out of a spin using rockets	Determination of the possibility of taking the aircraft out of a spin	UVVS	Report
		IU-th O t d e l			
34	fifty	Development of a new powder composition capable of burning at low pressures	Obtaining gunpowder suitable for traction rockets and non-kill shells	NTU GAU	Experienced batches and report
35	51	Development of a powerful rocket powder	Increasing the power of existing propellant rockets and phasing out the existing rocket powder	RNII	Experimental parties and report [7]

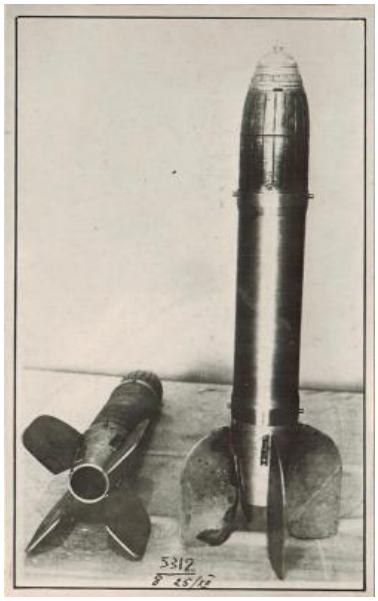
In 1934-1935, two engineers of the Jet Research Institute, comrade ALEXANDROV and Comrade PAVLOV carried out a large research work on the topic: "Development of the composition and method of manufacturing gunpowder for a rocket engine with a reduced burning rate."

The field of practical application of this powder is the so-called traction rockets, used as a propulsion device for installation on airplanes and rocket gliders.

During laboratory and factory tests, chemical studies have shown that the main task has been satisfactorily solved. The burning rate of the new powder composition is 60% lower than that of the smokeless powders that existed at that time. The new gunpowder was higher than the rocket powder used before [3].

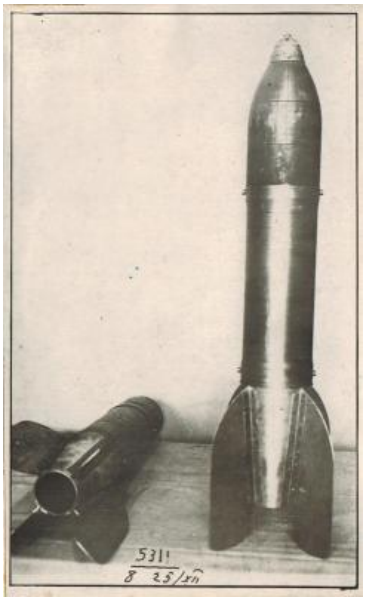
During 1934-1935, the specialists of the Jet Institute carried out the following major works, which included:

1. Development of an 82 mm high-explosive fragmentation projectile, which passed field tests by firing from the ground and from the I-5 aircraft. At the end of 1934, the AU of the Red Army ordered a batch of 500 shells to plant number 75 and 5000 shells to plant number 70. As of the end of the first half of October 1935, by that time the order had not yet been completed.

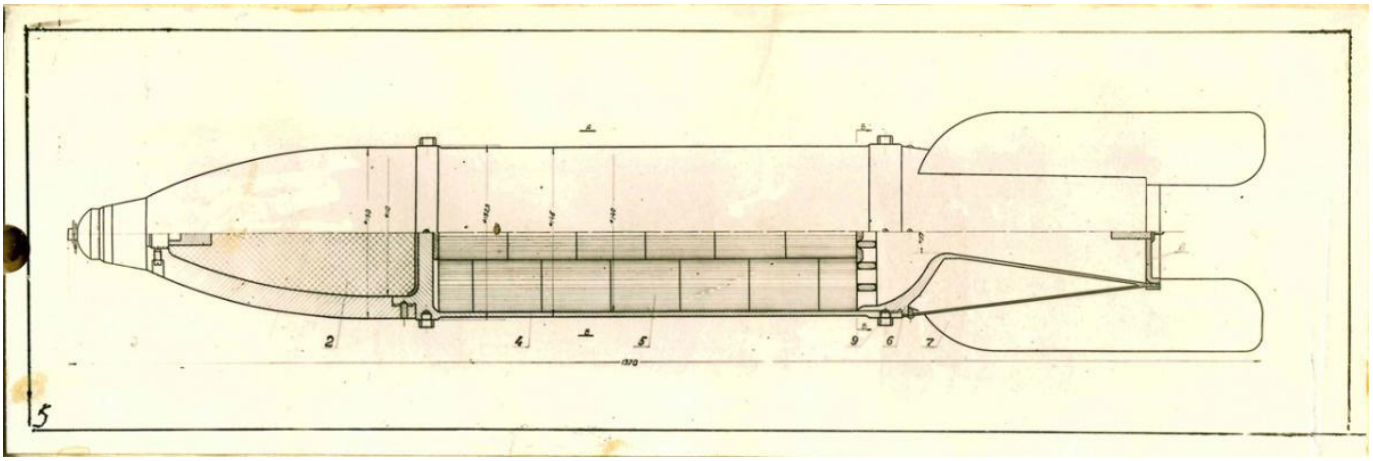


82mm high-explosive fragmentation missile projectile. Weight - 6.5 kg, speed - 350 m / s, range 5500 m accuracy 1 / 120-1 / 150 distance

2. Development of 132 mm high-explosive fragmentation missile projectile, which passed field tests by firing from the ground and from the R-6 aircraft. In 1934, an order was given to the industry in the same quantities as for 82 mm shells, but by the period indicated in the previous paragraph, it was also not fulfilled.



132mm high-explosive fragmentation missile projectile. Weight - 23 kg, speed - 350 m / s, range - 6500 m, accuracy 1 / 120-1 / 150 distance



Longitudinal section of a high-explosive fragmentation missile projectile

General view of the 6-gun 132 mm mount on the R-5 aircraft. Aggregates of 3 guns each are suspended under the lower fenders

Three-gun unit on the R-5 aircraft. Loading the gun

Three-gun unit for 132 mm shells under the wing of the R-6 aircraft. Unit weight without shells - 27 kg

3. Development of 132 mm rocket lighting projectile, which has passed field tests. In 1935, AU ordered a pilot batch from the industry. As of the end of the first half of October 1935, by that time the order had not yet been completed.

132 mm rocket lighting round on the machine before firing. Projectile weight - 18 kg, range - 5000 m, illumination radius - 1000 m, illumination time - 60 seconds

4. Development of a 68 mm rocket projectile for day and night action. The projectile has passed field tests. In 1935, AU ordered a pilot batch from the industry. As of the end of the first half of October 1935, by that time the order had not yet been completed.

5. Development of a 68 mm signaling missile projectile for day and night action, which has passed field tests. As of the end of the first half of October 1935, by that time the order had not yet been completed.

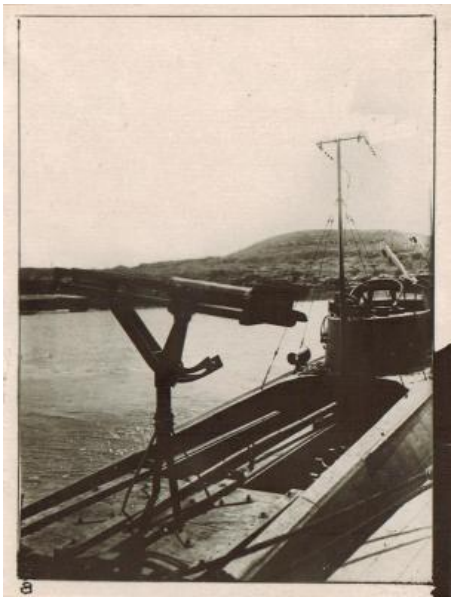
6. Development of a 245 mm high-explosive missile projectile, which has successfully passed factory firing tests. The drawings were handed over to the AU for ordering an experimental gross batch.

245 mm high-explosive missile projectile and firing range. Projectile weight - 120 kg, speed - 320 m / s, range - 800 m, accuracy 1/100 distance

7. Development of the design of a gun mount for firing 132 mm rocket projectiles from the BT-5 tank. Factory tests were carried out on a prototype with good results. In 1935, factory tests of a two-gun installation on the same tank were to be completed.

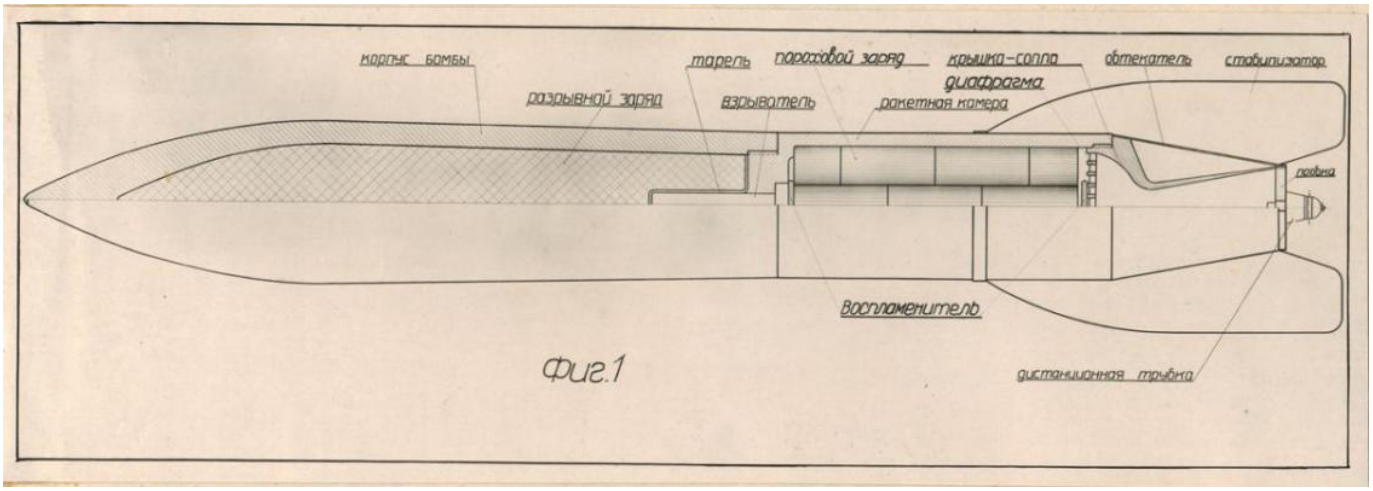
Installation for firing 132 mm rocket projectiles from the BT-5 tank / test sample /

8. Development of the design of a three-gun mount for firing 132 mm rocket shells from a torpedo boat. Factory tests were carried out by firing a prototype gun at sea, which gave good results. In 1935, field tests of a three-gun mount were completed on the same boat.



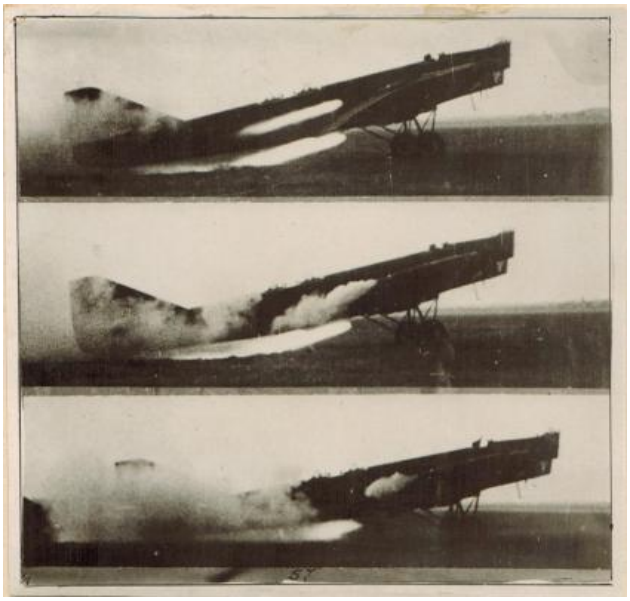
Installation for firing 132 mm rockets from a torpedo boat / test sample /

9. The theory of a rocket bomb and testing of prototypes of such bombs weighing 25 kg by bombing from an R-5 aircraft has been developed. The test results were approved by the Head of the Department. Tuning and testing of prototypes of missile bombs of this type, but weighing up to 1000 kg, was to be carried out in 1936.



Rocket bomb. Lengthwise cut

10. Two installations of a rocket powder engine for two TB-1 aircraft were built. Both aircraft successfully passed factory tests and were handed over to UVS for military trials. During military trials, defects were discovered that required immediate revision of the engine.



Acceleration of the TB-1 aircraft using a powder rocket engine / filming /. Average engine thrust - 6000 kg, reduction of takeoff run versus usual - by 80%

11. The first rocket engine was built and successfully tested, operating on liquid oxygen and alcohol and giving a thrust of 300 kg. The engine was intended for a high-altitude rocket, which was to be built in 1936.

12. Developed and for the first time in the USSR implemented an aerodynamic tunnel, giving flow velocities from 5000 to 1000 m, sec. Approved by the special expertise of TsAGI and entered into normal operation. A number of work was carried out on the blowing of shells on the instructions of the AU of the Red Army and the Artillery Institute.

13. A new powder of rocket projectiles has been developed and passed factory tests, exceeding the power of conventional rocket powder by 20%. In 1936, this gunpowder was to be transferred to industry for gross production.

14. Developed and successfully passed the factory tests of a 40 mm signal rocket projectile. At the end of 1935, AU drawings were to be handed over to order a gross batch.

15. Developed and successfully passed factory tests of a 60 mm rocket tracer non-killing projectile. At the end of 1935, AU drawings were to be handed over to order a gross batch.

Also, work was performed on which factory tests were not completed:

1. Development of 82 mm and 132 mm rocket projectiles at speeds up to 400 m / s.
2. Development of a 245 mm concrete-piercing shell.
3. Installation for firing 245 mm high-explosive and concrete-piercing projectiles from the TB-3 aircraft.
4. Installation for firing 245 mm shells from a destroyer.
5. Development of an aerial torpedo with a rocket engine with a range of up to 50 km.

The main new works for which the Institute received assignments for 1936 from the Non-Profit Organization Departments were:

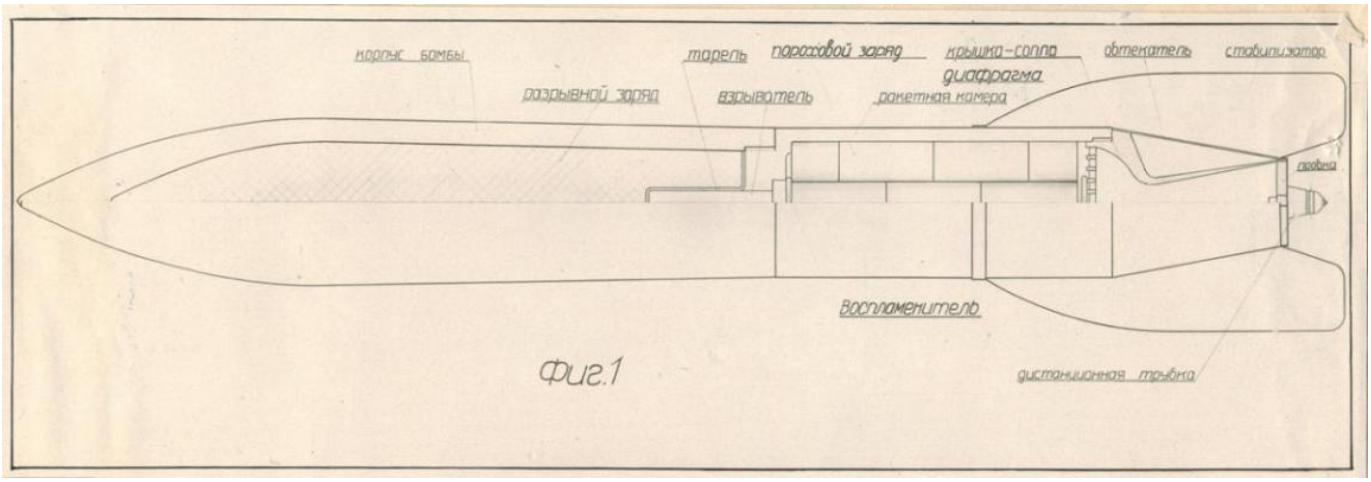
1. High-explosive fragmentation missiles 107 and 152 mm caliber.
2. Concrete-piercing rockets of 203 mm caliber.
3. High-explosive anti-submarine and anti-torpedo 152 mm shells.
4. Chemical 152mm shells.
5. Illumination and signaling shells of 152 mm caliber and 76 caliber.
6. Incendiary shells of 76 mm caliber.
7. Aircraft concrete-piercing bombs of 500 and 1000 kg.
8. Aerial torpedoes with telemetry control.
9. Catapult for naval aircraft [8].

Fragments from the bursting of an 82 mm fragmentation rocket projectile. When a rupture occurs, not only the combat head is crushed, but also all other parts of the projectile - the chamber, nozzle, stabilizer, etc.

You can shoot without a machine at all. To do this, it is enough to support the tail of the projectile into the ground, supporting it in the middle with a wooden cross. This method of firing is very convenient for chemical firing, as it will allow concentrating a huge number of shots in a small area, ensuring the speed and secrecy of preparation.

132 mm. Shooting rocket projectiles without the aid of a gun

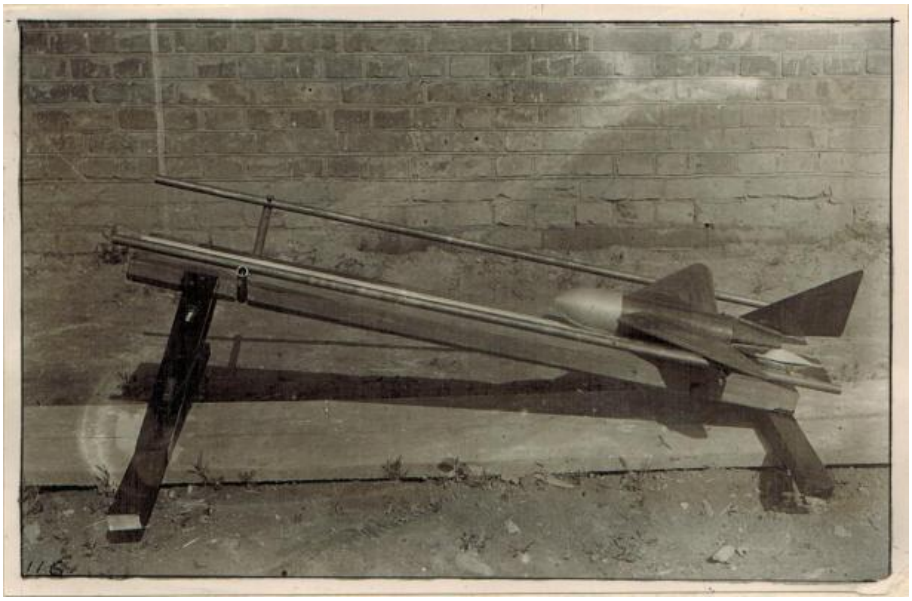
245 mm. Shooting rocket projectiles without the aid of a gun



In addition to shells, the Institute's specialists worked out the issue of rocket bombs. An aerial missile bomb differs from a conventional bomb in that it receives, shortly before falling to the ground, additional speed from a special charge, due to which its penetration capacity can be increased by 2-2.5 times.

Rocket bomb. Lengthwise cut

It was believed that a liquid propellant rocket engine could be installed on an automatically guided vehicle designed to destroy large air targets. A model was created, which is a cruise missile-torpedo.



Model of a cruise missile torpedo on the trigger [9]

In 1935, specialists of the Jet Research Institute completed the following objects:

1. Two TB-1 aircraft with missiles were handed over for military trials;
2. Huge tests were carried out on military torpedo boats in Sevastopol;
3. A standard (it is worth understanding bench-top) installation of an air jet engine was implemented and put into operation;
4. Ten inch rockets fired;
5. Aviation missile bombs have been tested, which give an impact velocity and penetration depth of 2 to 3 greater in comparison with the bombs put into service.

It was noted that the development of all these top secret facilities is extremely important for the defense of our country [3].

In December 1937, 82 mm high-explosive fragmentation missiles were adopted by the Red Army Air Force. According to the instructions of the Chief of the Air Force Comrade LAKTIONOV, for the widespread introduction of this type of weapon into the Air Force and the operation of this type of weapon, the 1st Main Directorate of the NKOP should have produced 30 launchers [10].

According to data relating to 1938, the main topic of Research Institute No. 3 was the study of the issue of rocket flying and the application of this principle for the purposes of national defense in the first place.

It was known that a rocket engine serves as a converter of the latent energy of fuel in a rocket into the relative kinetic energy of combustion products.

In a thermal rocket engine, a wide variety of combinations of oxidizers and fuels can be used, which, according to their physical state, could be divided into two groups: solid and liquid fuels.

In these two directions, basically, research work was carried out at the Institute.

Solid fuels for jet engines include gunpowder, liquid hydrocarbons with liquid oxidants in the form of liquid oxygen and various chemical compounds rich in oxygen.

The main topic of the Scientific Research Institute No. 3 of the People's Commissariat of the Defense Industry was the development of artillery samples of missile weapons - missiles and bombs for various purposes, such as fragmentation, high-explosive, concrete-piercing, armor-piercing, chemical, lighting, signal, etc.

The study of the rocket principle for the creation of weapons seems to be advisable in view of the absence of recoil when firing a low weight, the simplicity of the system, and a large filling factor.

The aforementioned properties made it possible to solve the issue of aviation armament, artillery of small and medium calibers from 82 mm to 203 mm, which at that time represented an unsolved problem for conventional artillery.

Using rocket shells as aerial bombs, giving them additional speed when falling, the extremely important task of increasing armor and concrete penetration is solved, which is unbearable for conventional aerial bombs.

Research Institute No. 3, in its work in 1938, continued to develop and improve the previously developed samples in the direction of increasing their accuracy, increasing the effectiveness of the target, increasing the flight speed of projectiles and searching for propellants that optimally meet the task, namely, giving steel combustion and normal behavior with temperature fluctuations in the external environment.

According to data from 1938, the specialists of the Institute developed and submitted the following samples for testing:

For the Air Force of the Red Army

In the second half of 1937, extensive tests were carried out on an 82 mm fragmentation missile projectile to arm fighter aircraft. These tests were carried out in a squadron under the command of the hero of the Soviet Union, comrade RYCHAGOV. During these tests, 1000 pieces of RS were shot, which received a positive assessment and the Air Force issued a pilot gross order to plant No. 70 (it is worth understanding an order for a pilot gross production). Plant No. 1 received an order for the development of rocket launchers on airplanes.

Work was carried out on a 132 mm rocket incendiary projectile and in 1938 an order was issued for an experimental-gross batch of plant No. 70, military tests were to be carried out in 1938.

Work was carried out on a 132 mm fragmentation missile projectile, which passed preliminary field tests and an order was issued for it for conducting extensive military tests in 1938.

In 1937, an 82 mm rocket incendiary projectile successfully passed field tests and an order was issued to plant No. 70 for an experimental gross batch for military tests.

In 1936, in Sevastopol, a 203mm missile bomb with an additional speed was successfully tested (passed in the document) and a pilot gross order was issued for it to plant number 78 for military tests. In addition to the above, the Institute's specialists developed the missile part of 254 and 305 mm missile bombs, the prototypes of which were to be tested in the first half of 1938. The samples were designed to penetrate armor up to 170 mm, and in the future it was possible to bring the armor penetration of a rocket bomb to a thickness equal to the caliber of the bomb.

The Institute's specialists also carried out work on a 132 mm illuminating rocket projectile for which in 1938 an order was issued for a pilot batch.

Another example was a 203mm high-explosive fragmentation missile projectile for arming a heavy bomber. The tests were to be carried out in the first half of 1938.

Another example was the 132mm rocket launcher for a high-speed bomber. The tests were to be completed in 1938.

For the Naval Forces of the Red Army

On the maritime theme, work was carried out on the following samples:

- 152mm missile illumination projectile with illumination duration up to 1 minute.
- 152mm signal day and night projectiles with a duration of up to 40 seconds.
- 152mm anti-submarine missile diving projectiles.

All the mentioned prototypes of missile weapons were developed on the instructions of the Directorate of the Naval Forces. They passed field tests in 1937 and met the set tactical and technical requirements. The next stage in the work on these samples was to be the conduct of military tests.

For Artillery Control

For the Artillery Administration, a sample was developed and an experimental batch of 68 mm tracer missiles in the amount of 250 pieces was manufactured. Field tests were to be carried out in the first half of 1938. At the same time, the Institute's specialists have developed launchers for all types of projectiles.

At that time, insufficient accuracy when firing rocket shells on the ground was the only obstacle to the widespread use of this type of artillery. Moreover, thanks to the handicraft and methodological flaws in the previous work of the Institute, until recently the main reason for the low accuracy was not established. The possibility was not excluded that the lowered accuracy was covered in the very principle by changes in aerodynamic shapes and structural changes in the missile-projectile itself, and it was impossible to bring accuracy to the state of artillery systems.

When firing rocket projectiles from an aircraft in flight, obviously due to the increased muzzle velocity of the rocket projectile due to the speed of the aircraft's movement, the power increases significantly and differs little from the accuracy of modern artillery. This circumstance gave reason to believe that missiles in aviation at the wrong time were out of competition and represented a powerful weapon for the air force.

Liquid fuels, such as gasoline, oxygen differ favorably from propellants, in terms of calorific value and the possibility of a continuous supply in the combustion chamber of the engine. Thus, high-calorie liquid propellants are used in the rocket engine and it was possible to increase both the speed of the outflow of combustion products, as well as increase the fuel supply in the rocket. This circumstance leads to an increase in the flight range of the apparatus in comparison with a powder rocket, this is especially true of the so-called air rocket engine, in which oxygen contained in the air is used as an oxidizer. Guided by these considerations and preliminary design data, the Institute carried out work in the direction of researching liquid-propellant rocket engines and air-rocket engines. Work in this part practically did not leave the field of laboratory research and, in general, the operation of the engine, both in terms of its efficiency and the duration of its operation, cannot be considered satisfactory, with the exception of some isolated successes. In parallel with the work aimed at mastering rocket engines on liquid fuel, the Institute for a number of years conducted research in the field of aircraft themselves, using the rocket principle for propulsion.

The main thematic tasks worked out at the Institute and KB-7 were research work on a liquid-propellant rocket engine for 150 and 300 kg.

Research on the objects of application of these engines: a wingless rocket, remote-controlled projectiles, research on a stratoplane, design of a jet gas generator.

These works, being primarily completely dependent on a reliably working engine, were also the subject of independent research. In addition, this part contained a significant number of technical problems of exceptional difficulty, such as:

1. Dynamic stability;
2. Flight controls
3. Development of rational design and fuel delivery, which were far from being used and even more so unresolved. Being at such a stage of development, these questions did not have clear and clear prospects for their application and could be classified as problematic issues.

At that time, the real defense topics of the Institute, in addition to rocket shells, armor-piercing and concrete-piercing rocket bombs, were:

1. Rocket start of the aircraft;
2. High speed wind tunnel;
3. Field catapult.

The rocket start of the aircraft after preliminary surveys in 1933 was allowed before military trials. During military tests, it was found that some of the components in the aircraft needed to be strengthened, and also due to the unsuccessful location of the launch rockets, damage to the aircraft tail plumage was found. On this basis, military tests were terminated and the experiments were suspended.

Calculations and experiments convinced that with the help of launch rockets installed on the aircraft, the takeoff distance of the aircraft at normal weight and the average take-off speed for modern aviation, the latter can be brought to 1/3 of the takeoff run of a normal aircraft with acceleration harmless to the crew. The possible overload of the aircraft during a rocket start is on average 127% of the normal useful weight. When using the specified overload to increase the fuel reserve, it is possible to increase the flight range by at least 95% compared to an aircraft of normal weight, i.e. without launch rockets.

The rocket launch payload can be increased by up to 5.3 times the normal weight aircraft. It is quite natural that when designing an aircraft, the requirements of a rocket launch should be taken into account, i.e. placement of missiles, strength of the corresponding parts. This task could have been completely solved in 1938, provided the capabilities of the rack of a small experimental aircraft were ensured.

The wind tunnel built at Research Institute No. 3 made it possible to study the laws of air resistance when moving bodies within the speed range from 340 to 1200 m / s.

At the construction site in the pipe, a more aerodynamically advantageous shape of the artillery projectile was found, which contributes to an increase in the range of 12-20% in comparison with the existing standard projectile *(in the document attire)* . This work was to be carried out in 1938 when shooting (by the Artillery Directorate) shells made from models at the range.

The main task of work in the direction of the development of aerodynamics of high speeds was a comprehensive experimental verification of the laws of air resistance when moving bodies at high speeds, which included shells, rockets and aircraft of the future [11].

According to the data from the first decade of 1938, the specialists of the Scientific Research Institute No. 3 of the NKOP, in accordance with the agreement with the Office of the Naval Forces of the Red Army, No.

- 152mm anti-submarine diving;
- 152mm signal-smoke (daytime) and 152mm signal light (night) for signaling both from ships and from the shore.

Factory tests in 1936-37, as well as tests at NIMAP "e, carried out in 1937 in the presence of representatives of ANIMI, showed that these first prototypes basically met the staged tactical and technical requirements [12].

According to the letter from the beginning of June 1938, by the beginning of April 1938, work had been carried out to test 24 mm and 40 mm sticks of various lengths in the temperature range from -20 to + 50 ° C. The test report was prepared by engineer POBEDONOSTSEV and sent from Research Institute No. 3 by letter No. 306s dated April 9, 1938 to the Head of Department 4 of Department 3 of Directorate B and MTS of the Red Army Air Force to Military Engineer 1st Rank Comrade LARMAN. At the end of the document it is written by hand: "The report of engineer Pobedonostsev UVV sent 3 / III 38 for N 185s."

These tests were carried out in order to determine the dependence of the maximum combustion pressure of a rocket charge from gunpowder NGV, as a function of the initial temperature of the checkers in RS drawing Z-0157.

In particular, the report noted that in the 132 mm chamber of the PC of drawing Z-0157, the pressure at a charge temperature of 15 ° C is an average of 230 kg / cm2, at a checker temperature of 35 ° C the average pressure under the same conditions, i.e. at ... = 23 mm it reaches about 370 kg / cm2. Verification tests carried out at Research Institute No. 3 Ing. FOKIN confirmed the data obtained by POBEDONOSTSEV [13].

In the first half of 1938, the specialists of Research Institute No. 3 performed the following works:

For the air forces of the Red Army

1. The work was completed and 82 mm fragmentation shells for fighter aircraft were put into service. During the specified period, the speed of the projectile already adopted for service was increased from 260 meters per second to 380-400 meters per second.
2. Military tests of 132 mm fragmentation projectile for arming fighter aircraft have been completed. No test report has been received. During the period under consideration, work was carried out to improve the speed increase to 400 mt per second and the fragmentation increased to 45 (in the source up to - 45).
3. The Institute has completed testing 82 and 132 mm incendiary shells. 40 shells were sent on August 10 to proving ground tests in Pavlograd, 40 shells were prepared for testing in the aviation unit.
4. The 203 mm bombs with additional speed were fully worked out and equipped. The products were shipped from plant No. 80 to Yevpatoria, where representatives of Research Institute No. 3 went to the same place. 132 mm RS were to be tested there. as a bombing means.

5. The development of a 132 mm illuminating shell at the Institute was completed. 20 shells were sent on August 10 to field tests in Pavlograd. 20 shells were prepared for testing in an air force.
6. 50 shells of 203 mm caliber were delivered to the customer. A gun mount was made, which by the time the document was drawn up (in the document now) was being mounted in Chkalovskaya, after which tests in the aviation unit were to be carried out in August-September.
7. A serial batch of 82 and 132 mm gun mounts for arming the unit, were manufactured in the 1st Glavka with a long delay.
8. All work on aerial bombs with additional speed by order of Research Institute No. 24 was completed. The products and representatives of the Institute went to Yevpatoria to conduct military tests together with Research Institute No. 24 and the Air Force.

For naval forces

In July 1938, field tests of 152 mm diving high-explosive shells were carried out. At the time of writing, the report had not been received. According to the representative of Research Institute No. 3, comrade SHVARTZ, the shells were approved for military trials for coastal defense. For military tests, 50 shells were made.

In July 1938, field tests of 152 mm lighting shells were carried out. At the time of writing, the report had not been received. According to the representative of Research Institute No. 3, comrade SHVARTZ, the shells were approved for military trials for coastal defense. For military tests, 50 shells were made.

In July 1938, field tests of 152 mm signal shells were carried out. At the time of writing, the report had not been received. According to the representative of Research Institute No. 3, comrade SHVARTZ, the shells were approved for military trials for coastal defense. For military tests, 50 shells were made.

Field tests of 152 mm smoke camouflage projectile with 5 kg of smoke substance were carried out, which revealed the insufficient effectiveness of these projectiles. At the suggestion of the Customer, these shells were taken out of production.

132 mm (at close range) smoke camouflage projectile with 25 kg of smoke substance, field tests were carried out (or should have been carried out) in Kronstadt between 5 and 10 August 1938.

Drafts of 132 mm smoke rocket gun mounts were made.

For the Artillery Department of the Red Army

The warhead and missile parts were tested. 100 shells of 132 mm chemical action were fired. In the last firing, accuracy was obtained that met the tactical and technical requirements. According to the data at the time of drawing up the document, 50 shells were tested at the training ground in Pavlograd and the results were not reported. The specialists of the Institute carried out work on the design of the construction of a special chemical motorized team for salvo fire of 72 rounds.

Participation in the development of the gross production of missile shells and installations.

- Work on the influence of temperature factors to improve the accuracy of R.S.
- Work on the elimination of temperature factors for all shells and bombs was completed. Under the leadership of representatives of the Institute, 16 tons of propellants were already manufactured at plant No. 59, and all tests of 1938 were carried out with propellants operating in the temperature range of +40 - -40 ° C.
- In the first half of the year, all the positions previously existing at the Institute and poor accuracy of the battle were checked.
- On orders in 1938, accuracy was slightly improved. But on the other hand, the reasons for poor accuracy were found, lying mainly in the area of active combustion of propellants. The test carried out with fast-burning sea powder ø 18 mm gave an improvement in accuracy by 2.5 times.

Field tests of 50 shells were carried out, the shape of 76 mm standard artillery shells was improved, which gave an improvement in accuracy by 2 times with an increase in range by 5%.

Work was carried out on liquid fuel engines.

The issue of using the development of the Scientific Research Institute No. 3 of the rocket launch was transferred to the 1st Main Directorate of the NKOP.

The project of a field catapult was developed and approved by the technical council. Began making the layout.

A laboratory was built and equipped, and research work on WFD began.

A pyrostarter was developed for plant 132.

In addition to the above-mentioned works, as above-planned work, projects were made and the first batches of R.S. with a defective standard 76 and 122 mm projectile head.

Very important work has been done to improve the gun mounts.

Military tests of 60 mm missile tracer shells were carried out [14].

The declassified documents also reflect the political component of the ongoing work of defense significance. So in one of the documents it is indicated that as a result of eliminating the consequences of sabotage in the intense work of the team of workers of Research Institute No. 3 during the fourth quarter of 1937 and three quarters of 1938, the specialists of the Institute carried out work on the design and development of a number of objects representing a very powerful new aviation weapon and special chemical parts of AC. This new type of armament, based on the rocket principle, received a good assessment from military experts and the commission.

In 1937, military tests were carried out, and at that time, work was underway to prepare for wide military exercises, by order of the Government, high-explosive fragmentation missiles of 82 mm caliber and installations for conducting targeted both single and multiple launch fire / 1-2-4-6 and 8 shells simultaneously / both on air and ground targets from I-15 and I-16 aircraft. The production of shells was transferred to the gross production of plant number 70, and the armament of 100 aircraft in 1938, the I-15 and I-16 with rocket launchers, according to the KO Resolution, was transferred to the 1st Main Directorate of the NKOP.

In 1938, military tests passed with an assessment of high-explosive fragmentation projectiles of 132 mm caliber and installations for aimed fire both at air and at ground targets from an SB aircraft. The production of shells was transferred to the gross production of the plant number 70.

As of November 1938, 203 mm high-explosive fragmentation missile projectiles and installations for aimed fire at both air and ground targets from the TB-3 aircraft were tested at the Noginsk scientific testing ground. The production of a serial batch was handed over to Plant No. 78.

In the city of Sevastopol, a special expedition of the RKKA UVVS conducted extensive field tests with a very positive assessment of concrete-piercing rocket bombs of 203 mm caliber, which received additional speed due to a rocket charge of about 180 m / s. In addition, the concrete-piercing and armor-piercing 203 mm, 254 mm and 305 mm calibers received a good mark in factory tests.

The development of 203 mm concrete-piercing bombs was completed, and they were handed over for bulk production to plant No. 78.

According to data from November 1938, on the basis of field test data, at present, it is necessary to consider spent rocket incendiary and lighting shells of 82 mm and 132 mm caliber for arming the I-15, I-16 and SB aircraft. The production of the gross batch was handed over to plant No. 70.

Designed and passed factory tests, and according to data for November 1938, a mechanized rocket launcher was prepared for extensive field tests at the AU test site. It was designed to provide chemical raid with 132 mm chemical rocket projectiles (SOV and NOV) with a capacity of seven liters. The installation made it possible to fire on areas with both single shots and volleys of 2-3-6-12 and 24 shots. Installations, brought together in batteries of 4-6 vehicles, were a very mobile and powerful means of chemical attack at a distance of up to seven kilometers [15].

According to the data from the letter ref. No. 965s of October 22, 1938 from the Research Institute No. 3 Head of the 13th Main Directorate of the NKOP comrade. Tolsky, on the basis of the findings of the Commission for the Inspection of Research Institute No. 3, was requested to exclude object No. 218 from the Institute's annual plan for 1938 - a theoretical and experimental study on the use of a rocket engine for human flight. The state of work on this object in 1938 was as follows.

The work began on January 1, 1938, as a continuation of the work on this topic, carried out in 1936 and 1937 by the leading engineer Korolev.

After several, relatively successful, tests of the rocket glider at the institute's stand on May 29, 1938, the facility crashed, during which the engineer Korolev, who conducted the tests, suffered (the author of the project). After that, for one month, engineer Korolev was in the hospital, and after leaving there he was arrested by the NKVD.

According to data from the second half of October 1938, a detailed study of the rocket glider and propulsion system was carried out, which showed that the propulsion system had such serious defects that its use for human flight could not be allowed. A clear proof of this was the above accident, in which the author of the project himself suffered. Therefore, from June 1, 1938, work on object 218 was stopped.

It was believed that bringing the motor system to a state that is safe for the experimenter would require the work of several people for one year, which at that time, due to the lack of suitable workers in group 2, could not be performed.

At the same time, there was a proposal from plant No. 1 of the NKOP (represented by one of the workers of that - engineer Shcherbakov) to take over the development of a rocket glider. Research Institute No. 3 supported this proposal of engineer Shcherbakov, taking into account the fact that in Research Institute No. 3 there were no aviation workshops or a test station, while at plant No. 1. In addition, engineer Shcherbakov had long been working on an issue close to a rocket glider. just over the stratospheric glider.

Taking into account all of the above, there was a request from Research Institute No. 3 to remove from the Institute's annual plan of work on object No. 218, especially since, according to available information, NKOP proposed in 1939 a contract for the construction of a rocket glider to conclude with plant No. 1, and not with Research Institute No. 3, offering the latter only the development of the engine.

In 1938, for facility 218, the Institute spent 61,296 rubles 11 kopecks out of 100,000 rubles allocated for this facility.

The rest of the funds 38 703 rubles 89 kopecks the Institute had to use for the development of objects proposed in a letter from the 13th Main Directorate of the NKOP dated July 26, 1938 No. 6109/473 [16].

Also at the end of October, there was a request from Research Institute No. 3 to remove object 219 - missile launch of aircraft from the annual plan of the Institute. Work on this object was carried out at Research Institute No. 3 in 1938 only until April 1, and after that it was stopped.

The situation was as follows. In the process of preliminary negotiations with the Head of the Research Department of the UVVS, it was decided to build a small aircraft specifically for conducting experiments on rocket launch.

However, during a meeting with the Head of the UMTS UVVS T. IOFFE, held on April 11, 1938, this method of work was rejected. A shorter path to solving this problem was indicated, namely, a device for a rocket launch of one of the existing aircraft. As such, Research Institute No. 3 recommended the aircraft DB-3, designed by comrade Ilyushin.

In fact, it turned out that this shorter route to solving the problem of rocket launch is more difficult and longer than the originally proposed construction of a small experimental aircraft. Turning to Comrade ILYUSHIN, Research Institute No. 3 received the answer that, firstly, its plant was loaded with planned work to capacity, and secondly, it does not need a rocket launch at all, for the reason that aircraft take off so well under normal launch conditions. The latter showed that Comrade ILYUSHIN

did not understand the tasks of a rocket launch, which should not be used under normal aircraft launch conditions, but under conditions when the takeoff of an aircraft on its own engines is generally impossible, for example, with a large aircraft overload and a poor airfield condition.

On the basis of Comrade ILYUSHIN's answer, Comrade BELYAIKIN, Chief of the 1st Main Directorate, told Research Institute No. 3 that the 1st Main Directorate refused to participate in the rocket launch of aircraft due to the workload of the Design Bureau and factories with Government assignments.

Since NII No. 3 was unable to carry out the equipment of the DB-3 aircraft for a rocket launch on its own (a major overhaul of the aircraft wing was required), NII No. 3 made a petition to Narkom comrade. KAGANOVICH, who referred the case to BONDAR. In the end, BONDAR returned all the materials from Research Institute No. 3 to Research Institute No. 3 without any instructions.

As of the end of October 1938, efforts to include the rocket launch in the experimental work plan 1 of the Main Board of the NKOP continued. However, it was believed that the 1st Main Directorate could begin work no earlier than 1939, if it agreed to do this work.

The costs for this facility were 8908 rubles 12 kopecks. Fulfillment of the originally planned annual plan by 25% [17].

As of the end of January 1939, there was no connection with related scientific institutions abroad for the reason that scientific achievements in the field of jet propulsion in the capitalist countries, as well as in our country, were classified. There were no scientific trips abroad. The use of foreign experience was carried out exclusively through foreign periodicals and is very limited for the reason that only fragmentary information of a general nature was found there, by which it was very difficult to judge even the general direction of ongoing scientific research in the field of jet propulsion, not to mention the transfer of foreign experience in the Institute.

Generally speaking, the specialists of the Institute carried out their scientific work solely on the basis of their own achievements and experience [3], but also studied the information that appeared from abroad with specialists from related organizations [18].

As of the end of January 1939, the main purpose of the institute was:

- Development of various types of missile shells, aerial bombs and launchers for them for firing from an aircraft in the air and on the ground.
- Development of rocket flying vehicles with liquid fuel engines for use as combat objects.
- Development of issues related to the use of reactive force for the ejection of aircraft [5], [19].

According to data from August 10, 1939, as a result of the work of specialists from Research Institute No. 3 in 1938-1939, the following were adopted:

- 82 mm high-explosive fragmentation projectile for arming fighter aircraft;
- 82 mm incendiary projectile for armament of fighter aircraft;
- 132 mm high-explosive fragmentation projectile for arming high-speed bombers;
- 132 mm incendiary round for arming high-speed bombers;
- 203 mm concrete and armor-piercing rocket bombs;
- launchers for firing from I15-I16 and SB aircraft;
- aircraft pyrostart - worked out jointly with specialists from plant number 132.

During this period, proving ground and state tests were successfully passed and was to be put into service in 1939:

- 132 mm rocket chemical projectile for 7 liters of OM;
- a mechanized auto installation for firing 132 mm chemical, high-explosive and special projectiles for A.U.
- 203 mm high-explosive fragmentation projectile for arming heavy bombers;
- 254 mm concrete-piercing missile bomb;
- 305 mm armor-piercing missile bomb.

In 1939, they were subject to field and plant tests:

- 82 mm, 132 mm, 203 mm armor-piercing missile shells;
- 203 mm chemical rocket projectiles;
- a mechanized installation for firing projectiles of 203 mm caliber.
- together with the aircraft designer Volkhovitin, a WFD installation based on a tunnel radiator was developed, which was supposed to increase the speed of the existing aircraft (or aircraft) to 80 kilometers per hour.
- airplane-glider with a liquid engine.

In addition to the above, the specialists of the Institute carried out scientific work on the study of the ballistics of missiles and aerial bombs.

In the gas-dynamic laboratory of the Institute, work was carried out to select the most rational forms of artillery shells in order to improve the range and accuracy.

Work was carried out on an air-jet engine as an engine for aviation.

Considering that such a complex topic required a sufficient material and scientific base, rapid tests carried out in the workshops of the Institute, the main obstacle in the faster solution of the tasks was:

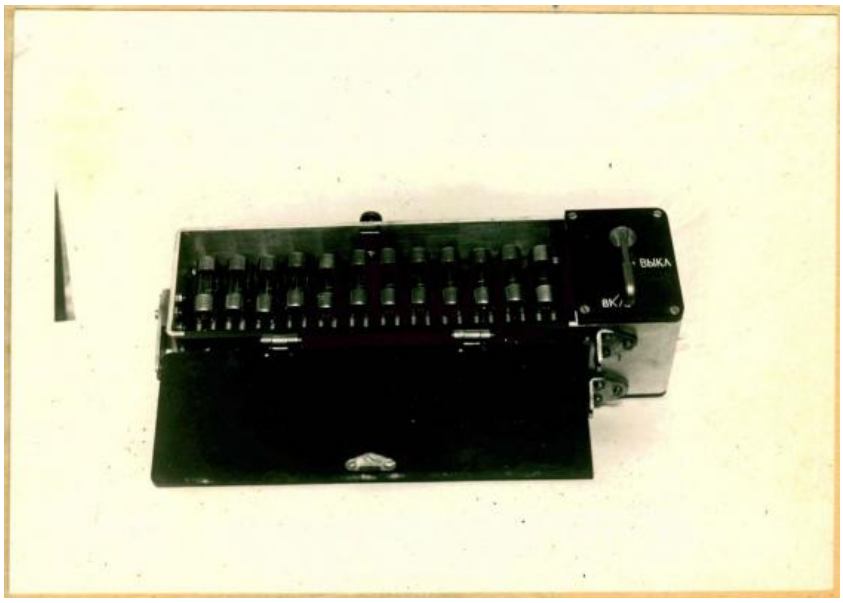
What hindered work	*Proposal for resolving issues*
Insufficient scientific and technical base.	Transfer to the jurisdiction of Research Institute No. 3 the premises that were at that time on the same territory / VISKHOM / as an organization that was not located at the place of its main production base.
Lack of sufficient cultural and living conditions for the engineering and technical staff	In 1940, to include in the NKB plan the construction of a residential stone house for 400 people. At the same time, in order to provide the urgently needed outstanding designers-order-bearers, the Mossovet allocated 1000 meters of living space to the Institute in 1939.
Lack of foreign information about the work on rocket technology abroad.Throughout its existence, the Institute has not sent its employees abroad.	Propose to the relevant NGO organizations about a special collection of information on jet technology. At the same time, the NKB sent a group of specialists abroad in 1939 to familiarize themselves with the state of the issue of rocketry, namely: Comrades Poida, Kostikov, Schwartz and Pobedonostsev.
NPO management is delaying testing of the Institute's facilities.Somehow: until now, the Air Force has not given us instructions on the type of aircraft that should be armed with large-caliber shells.	Suggest the Air Force to provide the Institute facilities in a timely manner with the material part
Gliding bomb trials are delayed due to non-delivery aircraft, heavy bomber.	
Until now, according to the research institute No. 3, the production base for the delivered samples has not been clarified	Propose to the NCO and the NKB to clarify the required number of shells and aerial bombs and in 1940 to provide a sufficient production base [20].

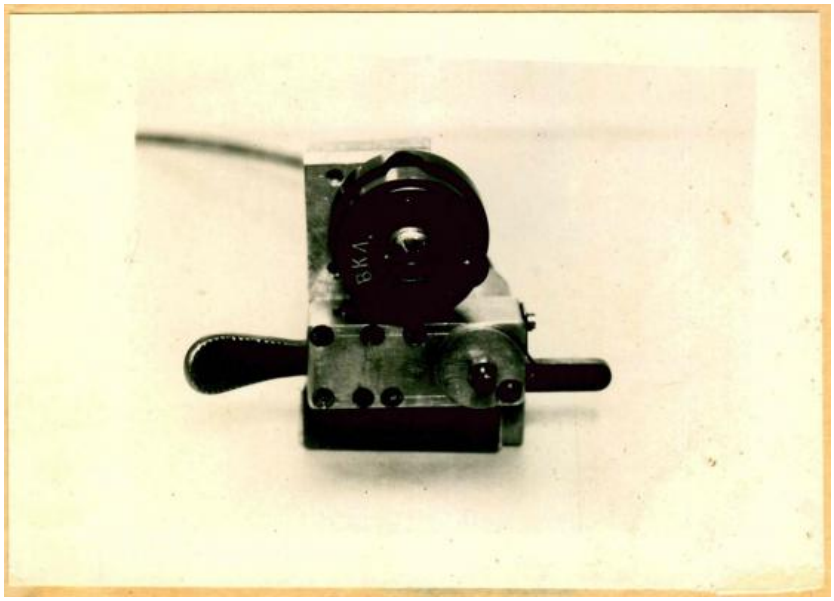
According to data from August 26, 1939, work was carried out on the fire control device R.S. different calibers.

This device was designed on the basis of the tactical and technical requirements approved by the chief of the 4th department of the 1st department of the 3rd department of the Red Army Air Force, military engineer Mironov 2nd rank.

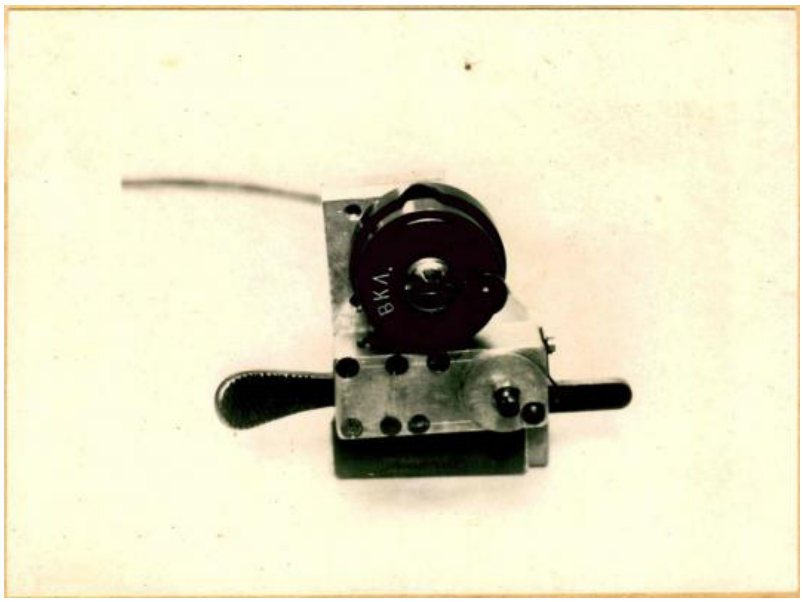
The purpose of the device is to be installed on an aircraft of any type for the production of firing R.S. of various caliber. The device was supposed to make it possible to fire R.S. single shots, a series and a salvo of 2,4,6,8 shots in a salvo.

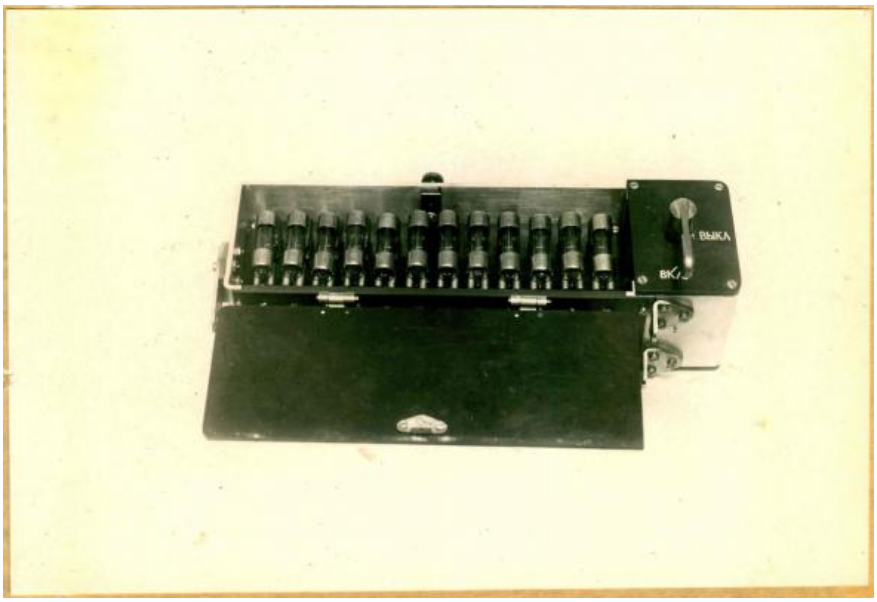
When firing serially, the device had to allow an interval from shot to shot of 0.3 seconds. After each shot, the device was supposed to record the number of shells fired.





СБРОШЕНО Р.С.


ВКЛ.


ВЫКЛ

Elements of fire control devices R.S. various calibers [21]

The framework of the prepared thematic plan of research and experimental work for 1940 envisaged theme 20 “Mechanized rocket launchers”.

The first purpose of the topic was to improve the design and performance of mechanized installations on cars and non-self-propelled salvo installations on trailers for calibers 132 mm and 203 mm with the aim of:

- increasing reliability and service life;
- simplification of the manufacturing process;
- ensuring complete safety and reliability of firing;
- improving performance (reducing the time for preparing to open fire and reloading ammunition, simplifying the repair technology in the field, providing convenient places for the team on the march).

The main stages of this work were to be:

- study of the generalization of the experience of industry and service in the troops (date: 01.01.1940 - 28.02.1940);
- the production of the project is improved. installations on a trailer (date: 03/01/1940 - 05/29/1940);
- development of working drawings, manufacturing and installation of one unit on a trailer (date: 01.05.1940 - 29.08.1940);
- production of extensive tests (date: 01.10.1940 - 29.11.1940);
- preparation of delivery drawings (deadline: 01.11.1940 - 29.12.1940).

In 1940, the work was to end with the delivery of an improved version of a mechanized installation and charging trailers for military tests, drawings, specifications and descriptions for implementation in industry.

The second target purpose of the theme was the development and testing of charging boxes-trailers with a maximum capacity of the RS, for transporting the latter from the base to the firing position, providing convenience and speed of reloading.

The main stages of this work were to be:

- project preparation (date: 01/01/1940 - 03/29/1940);
- production of working drawings (date: 03/01/1940 - 04/29/1940);
- production of installation parts and installation (deadline: 05/01/1940 - 07/29/1940);
- production of tests (time: 01.08.1940 g-29.08.1940);
- production of delivery drawings (deadline: 08/01/1940 - 09/29/1940).

In 1940, the work was to end with the delivery of the transporting device with a test report, delivery drawings, technical specifications and descriptions [22].

According to data from December 19, 1939, work was carried out on a gliding missile bomb (prototype, OE), designed to determine the possibility of a stable flight of this type of object in the gliding mode (see photos below, numbering from left to right) [23].

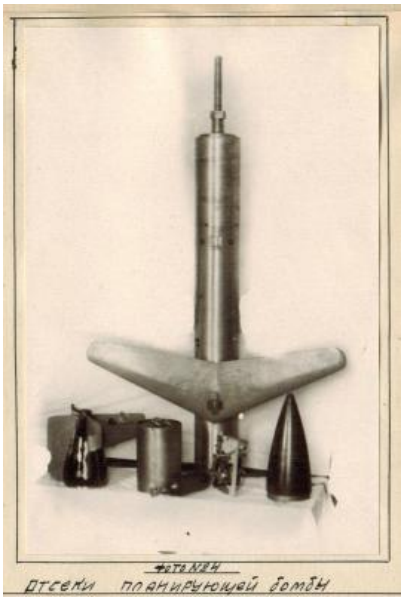


фото №4
Отсеки планирующей бомбы

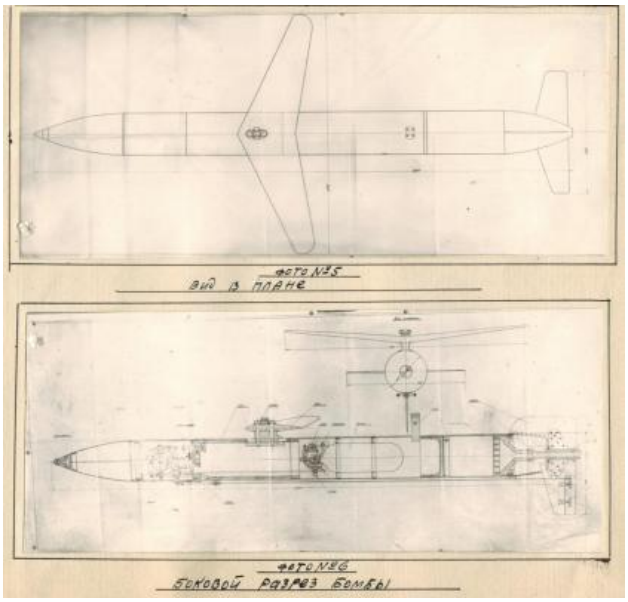
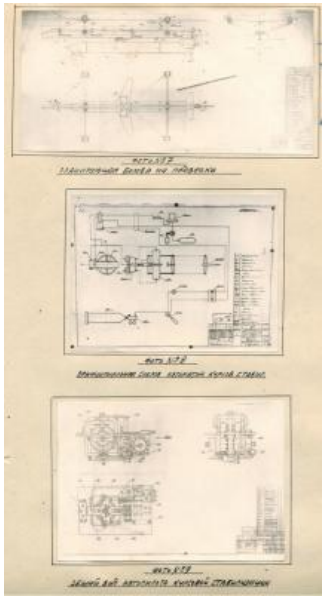
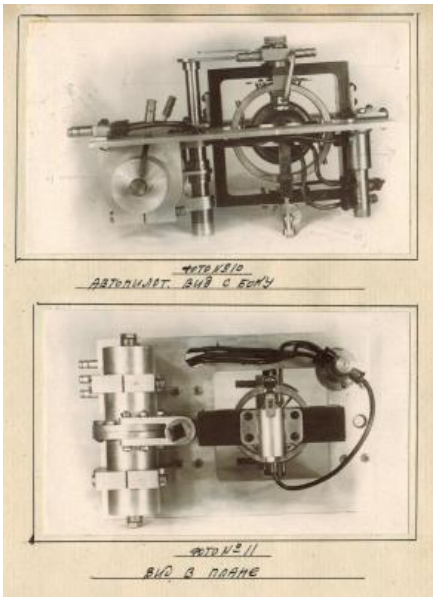
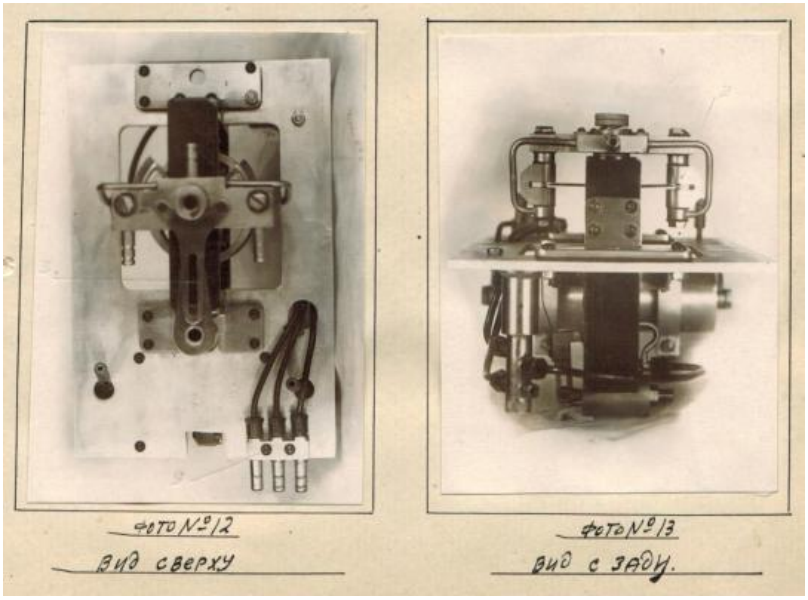


фото №5
Вид в плане

фото №6
Боковой разрез бомбы







According to data from the beginning of April 1940, in 1939, the specialists of the Scientific Research Institute No. 3 of the NKB developed and presented the following new models for service with the Red Army:

1. A mechanized installation (on the ZIS-6) for launching chemical and high-explosive shells of 132 mm caliber.

a / auto-installation ammunition consisted of 16 rocket shells;

b / the firing system provided for the possibility of firing both single projectiles and a salvo of the entire ammunition load;

in / the time required for the production of a salvo of 16 missiles - 3.5-6 seconds;

g / time required to reload the ammunition - 2 minutes, by a team of 3 people;

d / the weight of the structure with full ammunition was 2350 kg, which was 80% of the estimated load of the vehicle.

The document contains the following comparative data of a mechanized auto installation with howitzer artillery:

a / High-explosive fragmentation option. Taking the short-term rate of fire of a 122 mm howitzer and 152 mm 2 shots in 5 seconds, we get that within 5 seconds the auto-installation will fire 16 shells with a power equal to 75 kg of TNT and 395 kg of useful metal. In the same time:

A 122 mm howitzer emits 8 kg of TNT and 33 kg of useful metal.

The 152 mm howitzer emits 12.6 kg of TNT and 67 kg of useful metal.

Thus, one salvo of an auto installation is equal in power to 9.4 howitzers 122 mm and 6 howitzers 152 mm.

b / Chemical option. in one salvo for 3.5-5 seconds, 160 kg of OV is ejected from the auto-installation, while:

A 122 mm howitzer emits 4 kg of OM in two rounds.

The 152 mm howitzer emits 8 kg of OM in two rounds.

Hence, the volley of the auto-installation is equal in power to 40 122 mm howitzers and 20 152 mm howitzers.

To eject 1000 kg of OM from a rocket launcher, 2400 kg of metal will be required.

From 122 mm howitzers, 10,000 kg will be required.

Of 152 mm howitzers, 8000 kg will be required.

2. Rocket chemical projectile of 132 mm caliber

Full weight	42.8 kg.
Maximum speed	375 m / s
Maximum range	8800 meters
Number of O.V.	6.5 liters
Feature Weight (metal)	26.5 kg

3. Rocket high-explosive fragmentation projectile of 132 mm caliber

Full weight	42.9 kg
Maximum speed	346 m / s
Maximum range	8200 meters
Head weight	22 kg
Weight V.V.	4.7 kg.
Feature Weight (metal)	30.7 kg.

4. Concrete-piercing missile bomb of 254 mm caliber

Designed to destroy reinforced concrete floors.

Characteristics of BETAB-254-DS

total length	2475 mm
Total weight	364 kg.
Caliber	254 mm
TNT weight V.V.	31.9 kg
Rocket charge weight	31.8 kg
Additional velocity imparted to the bomb by the missile unit	170 m / sec.

5. Rocket armor-piercing aerial bomb of 254 mm caliber

Designed to destroy armored decks of warships.

Characteristics BRAB-254-DS

total length	2300 mm
Total weight	420 kg
Caliber	254 mm
Rocket charge weight	31.8 kg
Additional velocity imparted to the bomb by the missile unit	145 m / sec.

6. Rocket armor-piercing bomb of 305 mm caliber

Designed to destroy armored decks of warships.

Characteristics BRAB-305-DS

total length	2780 mm
Total weight	650 kg
Caliber	305 mm
TNT weight / V.V./	51.7 kg
Rocket charge weight	43 kg.
Additional velocity imparted to the bomb by the missile unit	128 m / sec.

7. Rocket concrete-piercing aerial bomb of 305 mm caliber

Designed to destroy reinforced concrete floors.

Characteristics of BETAB-305-DS

total length	3160 mm
Total weight	610 kg
Caliber	305 mm
TNT weight V.V.	74.27 kg.
Rocket charge weight	43 kg.
Additional velocity imparted to the bomb by the missile unit	138 m / sec.

The rocket part of all these samples provided the bomb with an additional impulse, increasing the manpower of the rocket bomb by the time it met an obstacle 2.5-3.5 times against a conventional bomb.

When bombing from a dive flight, the probability of hitting a target with a rocket bomb is better than a usual one due to a decrease in the time the bomb spends on its trajectory and its higher speed.

Rocket bombs were a fairly accurate, powerful and, perhaps, the only effective aviation weapon for destroying armored deck floors of warships and reinforced concrete fortifications.

8. Rocket lighting projectile of 132 mm caliber

a / luminosity - 400,000 candles;

b / burning time - 2 minutes.

Despite the fact that the mentioned samples were of great importance for the Red Army as a new, powerful and effective type of weapons, the issue of their introduction into industry, and, consequently, the timely equipping of the Workers 'and Peasants' Red Army with them, unfortunately, was unacceptably delayed.

Reporting on this, the director of Research Institute No. 3, Slonimer, asked for the intervention of comrade Osipenko to speed up the launch of these samples into industry [24].

According to the data at the end of January 1940, the Heads of Design Departments of Research Institute No. 3, Professor POBEDONOSTSEV Yu. A. and engineer I.I. took on the following SOCIALIST COMMITMENTS:

For the 4th Design Department (t. Pobedonostsev):

1. Design, manufacture and test a missile launcher mounted on a dive bomber, retractable in flight and capable of semi-automatic reloading. Deadline: July 1, 1940.
2. To design, manufacture, test and finally work out a lifting and loading device for large-caliber rocket projectiles. Deadline: May 1, 1940.

For the 2nd Design Department (t. Gwai):

1. Design, manufacture and test a mobile installation for anti-aircraft salvo firing of rocket projectiles, equipped with synchronous communication, remote guidance and fire control devices, as well as an autonomous source of electrical energy. Completion date: August 1, 1940.
2. To constructively work out and bring to military trials an installation on a sled for firing 450-500 mm missile mines. Completion date: April 1, 1940 [25].

According to data from the second half of February 1940, the Institute worked out and carried out all tests of a mechanized auto-installation, rocket-chemical and high-explosive fragmentation projectiles, which are required by NCOs. According to the NTZh and the decision of the People's Commissar of Defense, Comrade Voroshilov, the industry was required to manufacture 10,000 shells (of which 5000 chemical and 5000 high-explosive fragmentation shells) and 16 auto installations.

Despite the fact that the last tests were carried out six months ago, by the 20th of 1940, between the AU NKO and the NKB, there was a discussion of where to make shells and auto installations.

Considering that the task of Research Institute No. 3 and NKB was not only the design, but also the complete development of new types of weapons and their bringing them to the actual equipment of the Red Army, the director of Research Institute No. 3 NKB Slonimer asked for instructions on the manufacture of 10,000 shells at factories No. 70 and 16 installations at plant number 67.

For its part, Research Institute No. 3 was supposed to provide factories with the necessary assistance in the development of these products in production [26].

The main directions in the work of the institute, in accordance with the approved plan for 1940, were:

A. On RS and RAB

- Reducing the technical dispersion of rocket shells when firing on the ground;
- Increase of the RS flight speed in accordance with the increased aircraft flight speed;
- Increasing the range of the RS without reducing its effectiveness at the target;

- Final revision of armor-piercing missiles for aviation armament;
- Further improvement of launching devices for firing rocket projectiles;
- Simplification of the technological process of manufacturing PCs, RABs and starting devices.

B. On liquid-fueled RD and WFD

- Determination of the direction of effective use of these engines in artillery and aviation;
- Development of aggregates and individual units that ensure their specific use for creating combat models.

Research Institute plan No. 3 in 1940 mainly covered the following topics:

1. Missiles of various calibers and purposes - 17 topics;

2. Starting devices and their accessories

- ground installations - 7 topics;
- aircraft installations - 6 themes;

3. Rocket armor and concrete-piercing aerial bombs - 3 topics;

4. Long-range missile and related works about it *(no further text)* - 2 topics;

5. Research topics on the combustion of a powder charge in rocket chambers and external ballistics of shells - 5 topics;

6. Rocket engines and their application in aviation - 4 topics;

7. Simplification of the technological process for the manufacture of missiles and aerial bombs - 1 topic;

TOTAL - 45 topics;

The content of the above-planned tasks was as follows:

1. Development of new projects of rocket shells - 5;

2. Manufacturing of delivery batches of RS according to ready-made drawings - 5;

3. Manufacturing of starting devices:

- ground installations - 1;
- aircraft installations - 5;

4. Technical assistance to industry, design bureaus and non-profit organizations in mastering the manufacture and testing of RS and their parts - 8;

5. Separate tasks of an episodic nature - 5

TOTAL: 29.

In 1940, the following objects passed factory tests and were presented for field tests:

- 82mm armor-piercing missile projectile was submitted for repeated wider field tests after minor revision of the missile part (object 157, topic number 20);
- 132mm armor-piercing rocket projectile () object 158 on topic No. 21);
- 140mm flare projectile for the Navy and a mechanized auto-installation for automatic firing of 140mm flare projectiles (objects 129 and 213 on topics # 28 and 26);
- 82mm high-explosive fragmentation missile projectile for the Air Force. It differed from the standard RS-82, which was in service, in higher speed and more powerful warhead (object 141 and topic number 29);
- 140mm high-explosive fragmentation missile projectile for the Air Force. It differed from the standard RS-132, which was in service, by its higher speed and more powerful warhead (object 142 on topic No. 30);
- armor-piercing aerial bomb BRAB-800-DS (object 303, topic No. 19);
- a lift for loading the RS-203mm into the launchers mounted under the wing of the aircraft (object 422, topic No. 5);
- a rocket that throws a cable at a distance of up to 200 meters (object 230 of the superplan).

In 1940, factory tests or field tests passed and the following objects were admitted to military tests:

- BETAB - 20-DS (object 301 on theme No. 19);
- BETAB - 450-DS (object 702 on theme No. 19);
- BETAB - 750-DS (object 303 on theme number 19).

In 1940, there were objects admitted to military tests on the basis of the positive development of their individual components:

BRAB-250-DS missile part was similar to the BETAB-200-DS, and the warhead passed field tests (object 301 on topic No. 19);

The BRAB-500-DS missile part is similar to the BETAB-450-DS, and the warhead has previously passed field tests (object 302, topic number 19).

As a result of research work in 1940, the following positive results were obtained:

1. On the basis of fairly extensive studies of physical phenomena and regularities of the intra-chamber process in rockets with a powder charge, it was obtained:

- the ability to expand the operating temperature range of ± 50 ° C, instead of ± 40 ° C;
- the ability to outline a fundamental solution to the problem of partial similarity of the intra-chamber process, which will provide a sharp decrease in the cost of time and money required for developing objects
- the ability to increase the utilization rate of powder energy in rocket chambers;
- the possibility of streamlining the process of ignition and combustion of gunpowder, thereby reducing the dispersion of the RS in range.

2. In the course of extensive experimental research in the field of external RS balistics, it became possible to establish the main factors influencing the dispersion of RS. These include the muzzle velocity of the RS and the correct positioning of the stabilizer blades.

At the same time, it was experimentally shown that the geometric eccentricity of the nozzle within the limits obtained during the manufacture of the RS at plant No. 70 and the artificial twisting of the RS in flight does not significantly affect the dispersion.

3. The issue of simplifying the technological process of manufacturing the RS-82 was fundamentally resolved. According to preliminary calculations, due to the reduction of mechanical processing, this could reduce the cost of manufacturing the body by 30-40% and at the same time sharply reduce metal waste into chips.

4. Fundamentally, the issue of creating an RS and RAB with separate, sequential combustion of a rocket charge was resolved. This provided the opportunity:

- double the weight of the charge by lengthening the chamber without changing its diameter;
- to increase the probability of a hit during bombing from a dive flight and to ensure the conditions for firing large-caliber RS from under the wing of the aircraft;
- use the RS for shooting at short distances, to destroy powerful fortifications, by imparting additional speed to them on the descending branch of the trajectory.

5. Fundamentally, the issue was resolved and the main structural forms of building combined missiles (fuel: gunpowder and liquid components, nitric acid + kerosene) for shelling areas remote at a distance of more than 20 km were found.

6. The performed theoretical and computational research, the development of individual components and assemblies, the tests of the rocket airframe in flight, made it possible in 1940 to conclude that the rational use of liquid fuel rocket engines and air-rocket engines in application to aviation could be:

- creation of a combined propulsion system (liquid fuel rocket engine and ramjet rocket engine) for special super-high-speed interceptor fighters;
- creation of a rocket engine (or a system of engines using liquid propellants) for testing newly developed structures and aerodynamic shapes of an aircraft in full size at flight speeds greater than 100 km / h;
- creation of a ramjet rocket engine installation for modern high-speed aircraft, as an additional source of thrust to increase the aircraft's flight speed over short sections of the route.

Despite the positive moments in the work of the institute, in 1940 there were also negative factors in its work.

During the analysis of the work on the implementation of the 1940 plan, the following conclusions were obtained:

There was a wide discrepancy between the commitments made under the plan and the results of their implementation. So out of 45 planned topics, 10 topics were not completed and their completion was postponed to the next year, and 15 topics were completely stopped.

The reasons for the failure to fulfill the topics in the planned timeframe were:

- technical difficulties encountered in the development of new types of weapons and the inability to timely find the correct technical solution to issues that arise both within the institute and in other organizations: TsKB-22, NII-6, Plant 59, etc .;
- lack of necessary materials and insufficient efficiency of production management and, as a consequence, delay in the completion of the manufacture of pilot batches of RS, their equipment, and presentation to the customer (themes No. 42,27,28,29,32,37);
- unavailability in the industry of samples of missile ABs required for military tests (topic number 7, objects 301,302,303).

Removal from the plan in the termination of work on large-caliber missiles 165 and 355 mm and launching devices for them, as well as changes in the nature of tasks for a long-range missile (topics No. 2,23,24,28,12,13 and 38) were caused directive instructions of the Marshal of the USSR Comrade. KULIK about the need to first bring into service one caliber (RS-132), and then begin the development of shells of other calibers and purposes (see letter UVKA (probably UVNA) AU No. 668155s) dated 11/19/1940), and also his indication of the need to conduct further development in 1941 of a long-range missile in the context of obtaining its flight range of about 50 km.

As a result of work on topic No. 1 (object 153. Rocket projectile with a crushing chamber), it became clear that to obtain a satisfactory result in terms of fragmentation (characteristic D, for the entire projectile as a whole, with a useful fragment weight of at least 10 grams, should be about 25 -35) is only possible for large caliber shells. With a caliber of 140mm, the characteristic D = 15 was obtained, with a significant decrease in the flight speed and firing range of missile shells of this caliber,

which certainly follows unsatisfactory.

The development of a larger caliber projectile was carried out only in the form of projects in several versions, discussed at the NII-3 Technical Council. further development of the projectile was suspended on the basis of decisions of the Technical Council (see protocol NTS No. 41 of January 11, 1941) in connection with the letter from UVNA GAU No. 668155s.

The topics on an air rocket engine with a compressor and a rocket plane were not fully completed in the volume outlined in the 1940 plan and were discontinued due to the inappropriateness of the completion of individual stages of these works in the form that was planned at the beginning and the need to significantly expand them. and independent permission based on the tasks of the NKAP in 1941.

The timely change in the nature and scope of work on these topics was largely impeded by the delays in the consideration and approval of NII-3 projects submitted to the NKB and NKAP Technical Council on these issues.

Thus, on aviation topics (ramjet air-jet engine, air-jet engine with compressor, interceptor fighter jet), mainly individual specific issues were resolved, but not the problem in general, the use of this type of propulsion system in aviation.

Work on themes No. 35: "Rocket grenade for a rifle", and No. 39: "Rocket mine of 120mm caliber with additional speed" were discontinued due to the non-approval of the relevant NCO departments of the tactical and technical requirements for them.

The failure to fulfill the 1940 plan and a number of technical obligations was mainly due to the following circumstances:

- In 1938-1939, the specialists of the Institute pursued mainly utilitarian goals, i.e. forced application of previously accumulated experience to solve specific problems and did not pay enough attention to the development of research work;
- The haste of technical generalizations, as a result of the simplification of difficulties and the overestimation of strength and capabilities. This led to a technically unfounded commitment. For example, in the plan, in the column "how the work on the" project "ends, as a rule, on the RS, there was the wording" putting into service ", which clearly did not correspond to the Institute's capabilities, etc .;
- The qualifications of a significant number of employees of the Institute did not correspond to the level of the tasks assigned to the Institute;
- The weakness of the theoretical level of work and the lack of an experimental base;
- Complete inconsistency of the experimental base of the Institute on aviation topics to resolve the problem as a whole;
- Untimely development of the planned work of the Institute at the beginning of the year due to the workload of the main personnel and production with the work that arose in connection with the Finnish campaign [27].

According to the data of March 20, 1940, the director of the Research Institute No. 3 of the NKB Slonimer signed the Test Program, which was not approved by the People's Commissar of Ammunition of the USSR Sergeev, or we are dealing with a version of the document of the Research Institute No. 3. According to this program, work was to be carried out to test the following objects:

No.	An object	The purpose of the test	Test site	amount	Note
one	2	3	four	five	6
one	Test of ROS-82 from I-15 or I-16 aircraft	Defeat a moving and air target (pilots balloons) from a distance of 1000-1100 mt.	Shooting from horizontal flight of an aircraft at an altitude of 800-1000 mt. First approach-volley 2 shell. Second approach-volley 2 shell. The third approach is a salvo with 4 shells setting the tube with a scale.	ROS-82 8 pcs.	
2	Testing of ROS and RBS-82 from I-15 or I-16 aircraft	Defeat a ground target (a company in a marching column with a tank)	Shooting from a dive flight of an aircraft from an altitude of 1000-1500 mt. = 60-65 °. The first approach is a salvo of 4 high-explosive fragmentation. shells. The second approach is a salvo of 4 armor-piercing shells.	ROS-82 4 pcs.RBS-82 4 pcs.	RBS in sern. Equipment.
3	Tests of the BETAB-150DS from the DB-3 aircraft	Defeat area = 50 m.	Bombing from the horizon. flight from an altitude of 1500-2000 mt.A volley of 2 bombs.	BETAB-150 2 pcs.	Equipped in sulfur.
four	Test of the ROFS-132 from a cassette case, retractable into the bomb compartment, mounted in the model (in the document mequet) of the fuselage of the SAB aircraft	Shooting with explosions in the air at a distance of 1500-1700 mt.	Ground installation. Installation angle 20-30 °. Queue 8-10 pcs. The tube is installed with a scale.	ROFS-132 8-10 pcs.	
five	Testing of the RS-50 from the model of the fuselage of the SPB aircraft	Plywood board 10 × 10 mt. at a distance. 100 mt.	Shooting in 2 series of 10 pcs.	RS-50 20 pcs.	Equipped in sulfur.
6	Tests of ROFS-132 from a rocket launcher	Shooting ROFS-132 with a gap in the air at a distance of 2500-3000 mt.	Installation angle 4 hours 40 °. Shooting series 16 pcs. within 5-6 seconds.	ROFS-132 16 pcs.	
7	RKhZ-132 tests with a rocket launcher	Shooting RHM-132 with a gap in the air at a distance of 2500-3000 mt. (the head is filled with liquid colorant).	The same as in number 6.		
8	Test ROS-132 from a rocket launcher	Continuous lighting of the area at a distance of 3500-4000 mt.	Installation angle = 40 °. The interval between the shot is equal to the burning time of the torches of one shell.	ROS-132 8 pcs.	
9	Testing the RSS-132 with a rocket launcher	Shooting with bursts of the upper point of the trajectory with day and night signals	Installation angle = 40 ° single shots at intervals of 1-1.5 min.	RSS-132 4-5 pcs.	
ten	Tests of the RAS-132 with a rocket launcher	Leafing the area in depth from 1500-2500 mt.	Installation angle = 30 °. Shooting series 8 pcs. for 2-4 sec.installation of the tube with a scale.	RAS-132 8 pcs.	
eleven	Test RZS-132 with an anti-aircraft missile launcher	Shelling of the RZS-132 serving *(probably falling)* target from a parachute at an altitude of 2500-3000 mt.	Installation angle 65-70 °. Shooting in a series with a time interval in accordance with the target fall time. Installing the tube with a scale.	RZS-132. 16 pcs.	
12	Test of the M-1000 high-explosive missile mine from a mobile installation	Shelling of the area at a distance of 2000-2300 mt.	Installation angle = 40 °. Firing a series of full ammunition of the installation with an interval between shots of 0.5-0.8 seconds.	RM-1000 4 pcs.	In sulfur gear

thirteen	Rocket glider test	Testing of a rocket glider behind the towed P-5 aircraft at an altitude of 1000-1500 meters.	After the assessment (in the evaluation document) of the towing vehicle, the glider starts flight with a climb until the entire fuel supply in the engine is fully activated, the gliding descent [28].		

The document, dated July 30, 1940, sheds light on the history of the 140 mm rocket projectile (RS-140). The document provides data that the RS-140mm caliber appeared as a result of simplifying the technological process of manufacturing the RS-132mm rocket chamber. The existing 132 mm undercut in the rocket chamber was removed, and to maintain the internal diameter of the chamber, which was limited by the combustion process, the chamber diameter was expanded along the leading bulges. Thus, the RS-140mm caliber in 1940 was developed to abolish the RS-132mm blueprint [29].

ABOUT THE PERSONS WHO WORKED IN SRI No. 3

ABRAMOV B.F. - the author of the work, published in the collection of Proceedings of the Institute "Rocket Technology" No. 7 (it is worth understanding 1938) under the title "Laval nozzle in conversion conditions" [30].

ALEXANDROV Vladimir Ivanovich - In 1934-1935, the engineers of the Jet Research Institute com. ALEXANDROV and Comrade PAVLOV carried out a large research work on the topic: "Development of the composition and method of manufacturing gunpowder for a rocket engine with a reduced burning rate" [3]. Later he was the leading engineer of group 3 for missile bombs, military engineer of the 2nd rank. An initiative participant in the development of all calibers of rocket bombs and their range and military tests [31]. For collection No. 8 (it is worth understanding the collection of Proceedings of the Institute "Rocket Technology") Aleksandrov prepared the work "Rocket Air Bombs" [32].

BESSONOV - for the collection number 8 (it is worth understanding the collection of Proceedings of the Institute "Rocket Technology") prepared the work "Analytical determination of the size of the critical section of a rocket nozzle" [32].

GUAY Ivan Isidorovich - Head of Group No. 8, Leading Engineer. An active participant in the development of rocket launchers for the I-15, I-16 and SB aircraft and special installations for chemical rocket projectiles [31].

DRYAZGOV - for the collection number 8 (it is worth understanding the collection of Proceedings of the Institute "Rocket Technique") prepared the work "The movement of a guided missile pursuing a moving target" [32].

D UDAKOV - Leading engineer for object 219 - aircraft missile launch [17]. Professor Dudakov for the collection number 8 (it is worth understanding the collection of Proceedings of the Institute "Rocket Technique") prepared the works "Calculation of the action of a pneumatic shock absorber" and "Method for constructing the aerodynamic spectrum of a concurrent flow when gas is flowing into the free atmosphere" [32].

V. S. Zuev - for the collection number 8 (it is worth understanding the collection of Proceedings of the Institute "Rocket Technology") prepared the work "Determination of the impulse and thermal efficiency of a pulsating VRM" [32].

Kisenkov MS . - the author of works published in the collection of Proceedings of the Institute "Rocket Technology" No. 7 (it should be understood as 1938) under the titles "Air resistance with a feathered projectile at high flight speeds" and "Influence of the area at the top of the projectile on air resistance" (the latter in collaboration with Karavanov MV) [29]. Kisenko for the collection number 8 (it is worth understanding the collection of Proceedings of the Institute "Rocket Technology") prepared the work "Dependence of the shape coefficient on the external outline of an artillery shell" [32].

KOROLEV - Leading engineer, author of the project object No. 218 - theoretical and experimental research on the use of a rocket engine for human flight [33].

KOSTIKOV Andrey Grigorievich - Deputy Director for the technical department, military engineer of the 1st rank. Supervised the provision of technical guidance for military and range tests of missile shells and missile aerial bombs. He initiated the introduction of mechanized (originally rational) installations for chemical projectiles [34].

POBEDONOSTSEV YU.A. - the author of the work published in the collection of Proceedings of the Institute "Rocket Technology" No. 7 (it is worth understanding 1938) entitled "Selection of a nozzle to a rocket charge" [26]. Professor Pobedonostsev for collection number 8 (it is worth understanding the collection of Proceedings of the Institute "Rocket Technology") prepared the work "Calculation of the trajectory of the Rocket Projectile" [32].

POIDA Fedor Nikolaevich - Head of Scientific Group No. 3, military engineer of the 2nd rank. He was engaged in the development of designs of shells 82, 132 and 203 mm and was directly involved in military tests of objects [31].

RAUSCHENBACH - for collection No. 8 (it is worth understanding the collection of Proceedings of the Institute "Rocket Technology") prepared the work "Lateral stability of a cruise missile in the presence of an automatic stabilizer" [32].

SLONIMER Boris Mikhailovich - Director of the Research Institute No. 3, engineer, order bearer. He headed the Institute, whose specialists ensured the implementation of work on arming fighter and bomber aircraft with rocket shells and rocket bombs and a rocket mechanized installation for the Artillery Directorate [34].

M. N. Tikhonravov - the author of works published in the collection of Proceedings of the Institute "Rocket Technology" No. 7 (it is worth understanding 1938) entitled "Investigation of the factors affecting the accuracy of the battle of missile shells" and "Experimental characteristics of a rocket engine" [30].

SHVARTZ Leonid Emilievich - Head of Scientific Group No. 1, military engineer of the 2nd rank. He was engaged in the development of designs for shells 82, 132 and 203 mm caliber [34].

E. S. SHCHETINKOV - the author of the work published in the collection of Proceedings of the Institute "Rocket Technology" No. 7 (it is worth understanding 1938) entitled "Prospects for the use of liquid-propellant rocket engines for human flight" [30]. Shchetinkov for collection No. 8 (it is worth understanding the collection of Proceedings of the Institute "Rocket Technique") prepared the work "Application of an air rocket engine in aviation" [32].

As the information is processed, the materials of the article will be updated.

Sources:

1. Electronic appearance of a copy of the Order of the Revolutionary Military Council of the SSS of the Republics No. 0113 dated September 21, 1941. The stamp of the document is not specified due to the observance of the rules for declassifying archival documents. The paper version of the document was provided by the leading specialist of the State Research Center FSUE "Keldysh Center" (Moscow) IV Gumenna.
2. Letter Ref No. 552s dated 08/17/1935 from the HEAD OF RNII TO THE PEOPLE'S COMMISSIONER OF HEAVY INDUSTRY S S S R com. ORDZHONIKIDZE. Script. 08/17/1935 // Archive of the State Scientific Center of the Federal State Unitary Enterprise "Keldysh Center". Inv. 97. Op. 1. Unit xp. according to inventory 1. L. 135,139.
3. Letter Ex. A 705ss of 10/19/1935 from the DIRECTOR of the RNII I. KLEIMENOV in the C K VKP / b /, DEPARTMENT N A U K I com. G O R O W O V U. Original. 10/17/1935 // Archive of the State Scientific Center FSUE "Center of Keldysh". Inv. 97. Op. 1. Unit xp. according to the inventory 1.L. 140.141.
4. Letter Ex. No. 24os of 02/14/1939, DIRECTOR OF NII No. 3 SLONIMER AND DEPUTY DIRECTOR OF NII No. 3 MILITARY ENGINEER OF I RANK KOSTIKOV in V.P.K. Comrade MATVEEV. Copy // Archive of the State Research Center FSUE "Keldysh Center". Inv. 291. Op. 1. Unit xp. according to inventory 14. L. 53,54,55,64.
5. EXPLANATORY NOTE To the results of the activities of Research Institute No. 3 NKOP for 1938. DIRECTOR OF SRI No. 3 NKOPP SLONIMER AND HEAD OF THE PLANNED DEPARTMENT OF MOTHERLAND. Incompletely signed original (Signed only by Rodin). 01/28/1939 // Archive of the State Research Center FSUE "Center of Keldysh". Inv. 225. Op. 1. Unit xp. according to the inventory 12.L. 95.104.
6. The electronic form of a copy of Decree No. 104 of the Council of Labor and Defense On the Organization of the Reactive Institute dated October 31, 1938. The stamp of the document is not specified due to the observance of the rules for declassifying archival documents. The paper version of the document was provided by the leading specialist of the State Research Center FSUE "Keldysh Center" (Moscow) IV Gumenna.
7. PROJECT THEMATIC PLAN OF DEFENSE WORKS RNII for I935. Signed by the HEAD OF THE INSTITUTE I. KLEIMENOV. 10/22/1934 Copy // Archive of the State Research Center FSUE "Center of Keldysh". Inv. 97. Op. 1. Unit xp. according to the inventory 1. L. 9-12.
8. Letter A 780s dated 11/14/1936, DIRECTOR OF THE JET SCIENTIFIC RESEARCH INSTITUTE NKTP I. KLEYMENOV DEPUTY COMMISSIONER OF HEAVY INDUSTRY Comrade. P Y T A K O V U. Original. Otp. 11/13/1935 // Archive of the State Scientific Center of the Federal State Unitary Enterprise "Center of Keldysh". Inv. 97. Op. 1. Unit xp. according to inventory 1.L. 146-150.
9. COMBAT USE OF ROCKETS. Material signed by I. KLEIMENOV, HEAD OF RNII-NKTP. 4 / XI 35. Original // Archive of the State Research Center FSUE "Keldysh Center". Inv. 97. Op. 1. Unit xp. according to inventory 1. L. 161-166,172,173,174,176.
10. REPORT of the Director of Research Institute No. 3 SLONIMER B.M. DEPUTY PEOPLE'S COMMISSIONER OF THE DEFENSE INDUSTRY comrade COOPER. Unsigned document. Photocopy // Archive of the State Scientific Center of the Federal State Unitary Enterprise "Center of Keldysh". Inv. 227. Op. 1. Unit xp. according to inventory 8.L. 32.
11. CASE No. ____ Correspondence and guidance material of P.E.O. Started on 01/05/1937. Completed on 01/21/1939 / STATUS AND DIRECTION OF WORK R&D Institute No. 3. Document without date. Photocopy // Archive of the State Scientific Center of the Federal State Unitary Enterprise "Center of Keldysh". Inv. 227. Op. 1. Unit xp. according to the inventory 8.L. 9.11-17.
12. Letter Ex. No. 197s dated 03/10/1938. TO THE PEOPLE'S COMMISSIONER OF THE NAVAL FLEET OF THE USSR To the 1st rank army commissar comrade SMIRNOV. Copy: Deputy People's Commissar of the Defense Industry of the USSR Comrade COOPER. from the DIRECTOR of Research Institute No. 3 of NKOP Slonimer. A photocopy of a copy of the document // Archive of the State Research Center FSUE "Keldysh Center". Inv. 227. Op. 1. Unit xp. according to inventory 8. L. 8.8 ob.
13. Letter Ex. No. 464s dated 4 / VI 38 from the DIRECTOR of the Scientific Research Institute No. 3 NKOP SLONIMER AND DEPUTY DIRECTOR OF the Scientific Research Institute No. 3 VOENINGENERA 2nd RANK A. KOSTIKOV. A photocopy of the signed document. 06/01/1938 // Archive of the State Scientific Center of the Federal State Unitary Enterprise "Center of Keldysh". Inv. 227. Op. 1. Unit xp. according to inventory 8.L. 37.41.
14. Letter Ref No. 688s dated 08.08.1938 to the HEAD of the 13th Chief Directorate of the NKOP Comrade TOLSKY from the DIRECTOR of the Scientific Research Institute No. 3 NKOP P SLONIMER. A photocopy of the original. 08/07/1938 // Archive of the State Scientific Center of the Federal State Unitary Enterprise "Keldysh Center". Inv. 227. Op. 1. Unit xp. according to inventory 8.L. 55,56,57,61.
15. Letter No. 1093ss of 20.11.1938 from the HEAD of the 13th Chief Directorate of the NKOP of the TOLSK PEOPLE'S COMMISSIONER OF THE DEFENSE INDUSTRY Comrade. M. M. Kaganovich Data about Tolskoye are crossed out. The document can be attributed to the working version of the letter. 11/17/1938 // Archive of the State Scientific Center of the Federal State Unitary Enterprise "Center of Keldysh". Inv. 227. Op. 1. Unit xp. according to inventory 8.L. 94-96.98.
16. Letter ref. No. 965s dated 10.22.1938 from the DIRECTOR of the Research Institute No. 3 NKOP Slonimer (no signature), Vrid. Beginning Planning department Dementieva, Head of gr. No. 2, Professor Dudakov TO THE HEAD OF THE 13TH MAIN DEPARTMENT OF NKOP Comrade. ONLY. Incompletely signed document. 10/19/1938 // Archive of the State Scientific Center of the Federal State Unitary Enterprise "Keldysh Center". Inv. 235. Op. 1. Unit xp. according to the inventory 9.L. 124-126.
17. Letter ref. No. 9683s dated 10/27/1938 from the DIRECTOR of the Research Institute No. 3 NKOP P SLONIMER, Lead Engineer 219 of the object and the beginning. 2 groups DUDANOVA, Acting Head of the Planning Department DEMENTYEV. Script. 10/26/1938 // Archive of the State Scientific Center of the Federal State Unitary Enterprise "Center of Keldysh". Inv. 235. Op. 1. Unit xp. according to the inventory 9.L. 127,128.
18. Letter Ex. No. 530s dated 06/20/1938 from the DIRECTOR of the Scientific Research Institute No. 3 SLONIMER TO THE HEAD OF THE AIR DEFENSE OF THE RKKA. The original // Archive of the State Research Center FSUE "Keldysh Center". Inv. 235. Op. 1. Unit xp. according to the inventory 9.L. 53.
19. BRIEF TECHNICAL REPORT on the implementation of work on "project number 218. Original. 09.01.1939 // Archive of the State Scientific Center of the Federal State Unitary Enterprise" Center of Keldysh ". Inventory 225. Inventory 1. Unit inventory according to inventory 12. Sheet 88, 90.

20. Letter Ex. No. 1133s dated 10.VIII 39g. from the DIRECTOR of Research Institute No. 3 N.K.B. SLONIMER in Ts.K. V.K.P. / b / comrade MONAKOV. The original // Archive of the State Research Center FSUE "Keldysh Center". Inv. 291. Op. 1. Unit xp. according to inventory 14.L. 124-126.
21. DESCRIPTION OF THE FIRE CONTROL DEVICE R.S. DIFFERENT CALIBERS. - SCIENTIFIC RESEARCH INSTITUTE № 3 N.K.B. GRU P A № 8. - 1939. Signed, but not approved document // Archive of the State Research Center FSUE "Center of Keldysh". Inv. 327. Op. 1. Unit xp. according to inventory 18. L. 34,35,41-43,50.
22. T E M A T I CH E S K I J P L A N SCIENTIFIC - RESEARCH AND EXPERIMENTAL WORKS FOR 1940. FOURTH CHAPTER MANAGEMENT N.K.B. SCIENTIFIC - RESEARCH INSTITUTE № 3. Incompletely signed document. 29.1X.39r // Archive of the State Research Center FSUE "Keldysh Center". Inv. 376. Op. 1. Unit xp. according to inventory 16.L. 129.140ob, 141.159ob, 160.
23. DESCRIPTION OF THE PLANNING BOMB / EXPERIMENTAL INSTANT /. Script. 19.XP.39. // Archive of SSC FSUE "Keldysh Center". Inv. 327. Op. 1. Unit xp. according to inventory 18.L. 164,167,168-171.
24. Letter ref No. 622s dated 8 / IV 40 of the DIRECTOR of the NII No. 3 SLONIMER in the KREMLIN. DEFENSE COMMITTEE S.S.S.R. Comrade OSIPENKO. Script. I.IU.40 // Archive of the State Research Center FSUE "Keldysh Center". Inv. 348. Op. 1. Unit xp. according to the inventory 19.L. 21-23.
25. Letter No. 176ss dated I / II 40. from the HEAD OF 4 DESIGN DEPARTMENT PROFESSOR POBEDONOSTSEV, HEAD 2 DESIGN DEPARTMENT AND N G E N E R A G V A I DEPUTY NATIONAL COMMISSIONER OF AMMUNITION OF THE UNION SSR Comrade. C O D I K O V U. Original. 25.I.40y // Archive of the State Research Center FSUE "Keldysh Center". Inv. 348. Op. 1. Unit xp. according to the inventory 19.L. 12.13.
26. Letter No. 271ss dated 20 / II 40 from the DIRECTOR of the Scientific Research Institute No. 3 of the NKB to the DEPUTY PEOPLE'S COMMISSIONER OF AMMUNITION OF THE USSR Comrade. Khodyakova A.K., COPY: TO THE HEAD OF THE 4TH CHIEF DEPARTMENT OF NKB Comrade. IVANOV. Unsigned document. I7.P.40 // Archive of the State Research Center FSUE "Keldysh Center". Inv. 348. Op. 1. Unit xp. according to inventory 19. Sheet 10.
27. EXPLANATORY NOTE TO THE REPORT ON THE IMPLEMENTATION OF THE WORK PLAN IN THE I940 YEAR OF THE WORK PLAN OF SRI No. 3 from the Acting Director of the SRI No. 3 VOENZHENER I RANK KOSTIKOV. The performers are Kostikov and Pobedonostsev (there is a Pobedonostsev visa). Script. 01/14/1941 // Archive of the State Scientific Center of the Federal State Unitary Enterprise "Keldysh Center". Inv. 465. Op. 1. Unit xp. according to inventory 26P. L. 2.4-9.11.
28. TEST PROGRAM. Signed by the DIRECTOR of the Scientific Research Institute No. 3 of the NKB SLONIMER. Not approved by the PEOPLE'S COMMISSIONER OF AMMUNITION SERGEEV "" March 1940. A signed but not approved document // Archive of the State Research Center of the Federal State Unitary Enterprise "Center of Keldysh". Inv. 348. Op. 1. Unit xp. according to inventory 19.L. 19.20.
29. Letter Ref 1225s dated 30 / VII-40 from the DIRECTOR of the Scientific Research Institute No. 3 of the NKB SLONIMERA TO THE PEOPLE'S COMMISSIONER OF THE UNION AMMUNITION S.SR. Comrade I. P. SERGEEV Script. 30.UP.40g // Archive of the State Scientific Center of the Federal State Unitary Enterprise "Keldysh Center". Inv. 348. Op. 1. Unit xp. according to the inventory 19.L. 80.82.
30. EXPLANATORY NOTE To the results of the activities of Research Institute No. 3 NKOP for 1938. DIRECTOR OF SRI No. 3 NKOPP SLONIMER AND HEAD OF THE PLANNED DEPARTMENT OF MOTHERLAND. Incompletely signed original (Signed only by Rodin). 01/28/1939 // Archive of the State Research Center FSUE "Center of Keldysh". Inv. 225. Op. 1. Unit xp. according to the inventory 12.L. 95,101,104.
31. Letter No. 1093ss of 20.11.1938 from the HEAD of the 13th Chief Directorate of the NKOP of the TOLSK PEOPLE'S COMMISSIONER OF THE DEFENSE INDUSTRY Comrade. M. M. Kaganovich Data about Tolskoye are crossed out. The document can be attributed to the working version of the letter. 11/17/1938 // Archive of the State Scientific Center of the Federal State Unitary Enterprise "Center of Keldysh". Inv. 227. Op. 1. Unit xp. according to inventory 8.L. 94.98.
32. EXPLANATORY NOTE To the results of the activities of Research Institute No. 3 NKOP for 1938. DIRECTOR OF SRI No. 3 NKOPP SLONIMER AND HEAD OF THE PLANNED DEPARTMENT OF MOTHERLAND. Incompletely signed original (Signed only by Rodin). 01/28/1939 // Archive of the State Research Center FSUE "Center of Keldysh". Inv. 225. Op. 1. Unit xp. according to the inventory 12.L. 95,101,102,104.
33. Letter ref. No. 965s dated 10.22.1938 from the DIRECTOR of the Research Institute No. 3 NKOP Slonimer (no signature), Vrid. Beginning Planning department Dementieva, Head of gr. No. 2, Professor Dudakov TO THE HEAD OF THE 13TH MAIN DEPARTMENT OF NKOP Comrade. ONLY. Incompletely signed document. 10/19/1938 // Archive of the State Scientific Center of the Federal State Unitary Enterprise "Keldysh Center". Inv. 235. Op. 1. Unit xp. according to the inventory 9.L. 124,126.
34. Letter No. 1093ss of 20.11.1938 from the HEAD of the 13th Chief Directorate of the NKOP of the TOLSK PEOPLE'S COMMISSIONER OF THE DEFENSE INDUSTRY Comrade. M. M. Kaganovich Data about Tolskoye are crossed out. The document can be attributed to the working version of the letter. 11/17/1938 // Archive of the State Scientific Center of the Federal State Unitary Enterprise "Center of Keldysh". Inv. 227. Op. 1. Unit xp. according to the inventory 8.L. 94.97.98.